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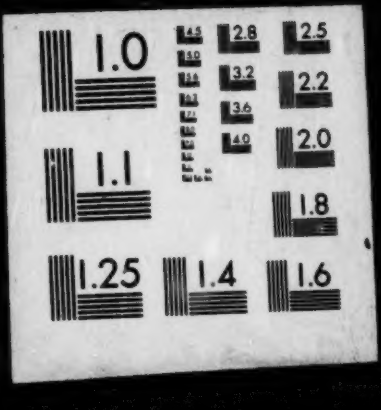
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Projects of the Pollution Control Analysis Section, November 1972

Environmental Protection Agency, Washington, D C

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NOVEMBER 1972

Environmental Protection Technology Series

Projects of the Pollution Control Analysis Section November 1972

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Washington, D.C. 20460

RESEARCH REPORTING SERIES

Research reports of the Office of Research and Monitoring, Environmental Protection Agency, have been grouped into five series. These five broad categories were established to facilitate further development and application of environmental technology. Elimination of traditional grouping was consciously planned to foster technology transfer and a maximum interface in related fields. The five series are:

1. Environmental Health Effects Research
2. Environmental Protection Technology
3. Ecological Research
4. Environmental Monitoring
5. Socioeconomic Environmental Studies

This report has been assigned to the ENVIRONMENTAL PROTECTION TECHNOLOGY series. This series describes research performed to develop and demonstrate instrumentation, equipment and methodology to repair or prevent environmental degradation from point and non-point sources of pollution. This work provides the new or improved technology required for the control and treatment of pollution sources to meet environmental quality standards.

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The purpose of this booklet is to provide a listing of all active and completed research, development and demonstration projects funded by the Environmental Protection Agency and its predecessor agencies through the Office of Research and Monitoring, Technology Division, Applied Science and Technology Branch, and under the management and technical direction of the Pollution Control Analysis Section. The information reported for each project includes most commonly requested specific information such as the title of the project, the name of the contractor or grantee, and financial data along with a brief description of the project.

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PROJECTS OF THE POLLUTION CONTROL ANALYSIS SECTION

November 1972

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Office of Research and Monitoring
Environmental Protection Agency
Washington, D.C. 20460

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15303 FMZ Programmed Demonstrations for Erosion and Sediment Control Specialist - - - - - - - - - - - - - - - - - - - 122
15030 HIX Erodibility of Urban and Suburban Construction Site Subsoils as Predicted by Chemical, Mineralogical and Physical Parameters - - - - - - - - - - - - - - - - - - 123
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I INTRODUCTION

The purpose of this booklet is to provide a listing of all active and completed research, development and demonstration projects funded by the Environmental Protection Agency and its predecessor agencies through the Office of Research and Monitoring, Technology Division, Applied Science and Technology Branch, and under the management and technical direction of the Pollution Control Analysis Section. The information reported for each project includes most commonly requested specific information such as the title of the project, the name of the contractor or grantee, and financial data along with a brief description of the project. Projects are divided into program element groups and subdivided as active and completed projects. They are then listed in numerical order (generally chronological) using the project numbering system in current use at the time of project initiation by the Environmental Protection Agency and its predecessor agencies.

Projects under the direction of the Pollution Control Analysis Section may have been funded under any of three sections of the Federal Water Pollution Control Act, as amended. Section 5 of that Act provides broad authorization for research, investigations, training and information. Section 6 authorizes, inter alia, projects for research and demonstrations for the prevention of pollution of waters by industry including industrial waste. Section 14 provides for the demonstration of the technical and economic feasibility and practicability of methods for the elimination or control of mine drainage pollution.

The projects under the direction of the Pollution Control Analysis Section include a wide and diverse technological area. The program area of Mining Sources is concerned with the development of solutions to the pollution problems caused by mineral industry discharges such as acid and other mine drainage, muds and brines from oil extraction, slimes from phosphate mining and sediment from the many facets of mining and processing. Hydrologic Modification includes the pollution caused by construction projects, impoundments, dredging and landfills.

Our objectives are to develop techniques for the control and abatement of these problems and to demonstrate the practicality of their application to the States, industry and private citizens, so that the techniques developed may be used by these groups. Although this development work may occasionally involve some "research," most of the work done by grantees and contractors is of a practical nature directly related to the solution of immediate problems.

Mine drainage is one of the oldest pollution problems known. It was known in medieval England that the water from a coal bed was colored yellow, and this knowledge was used by the early American explorers who predicted the presence of coal deposits from the color and condition of many streams. Technically, it is an extremely difficult problem to solve, both because of the inaccessibility of the pollutant source and the chemical nature of the water pollution. Unlike most other forms of pollution, mine drainage does not stop when the mining operation ceases production, but continues unabated and may even worsen with time after production has ceased and all men and machinery have vacated the mining operation.

Table I, which follows, illustrates the broad range of activities of the Pollution Control Analysis Section. It should be noted that all of the activities are directly earth related, and hence form a coherent group of technologies which is meaningful to place under the direction of a single group of people.

Figure I shows the U.S. mineral production in billions of dollars for 1964 and 1969 and compares the value of mineral production with the dollar value of the motor vehicles and the iron and steel produced in 1969. As can be seen, the value of the total mineral production is larger than that of the motor industry or the iron and steel industry. This is one of the indications of the importance of the mineral industry and its pollution problems.

Figure II shows the amount of the various types of minerals produced in the United States in 1969 in millions of short tons, the number of states producing the various minerals, and the state which is the leading producer of the mineral. With the large number of states producing any one mineral, it can be seen that the problem of environmental degradation caused by mining activities is extremely widespread and no state is free from mining pollution problems.

Figure III illustrates the general location of coal fields throughout the United States and the nationwide magnitude of the problem of mine drainage and other coal mining related pollution, such as sedimentation, etc.

Table II is a list of the published reports of the Pollution Control Analysis Section which are available from either the Government Printing Office or the National Technical Information Service. Table III is a listing of the projects for which the final report is being written, and should be available from the Government Printing Office in the near future.

For further information concerning these projects, please contact the Chief, Pollution Control Analysis Section, Office of Research, Environmental Protection Agency, Washington, D.C. 20460.

TABLE I

POLLUTION CONTROL ANALYSIS SECTION

MINING SOURCES

Coal Mining

Oil Production

Oil Shale

Ore Mining

Mineral Mining

Demonstration of Techniques for
Mine Drainage Pollution Control

HYDROLOGIC MODIFICATION

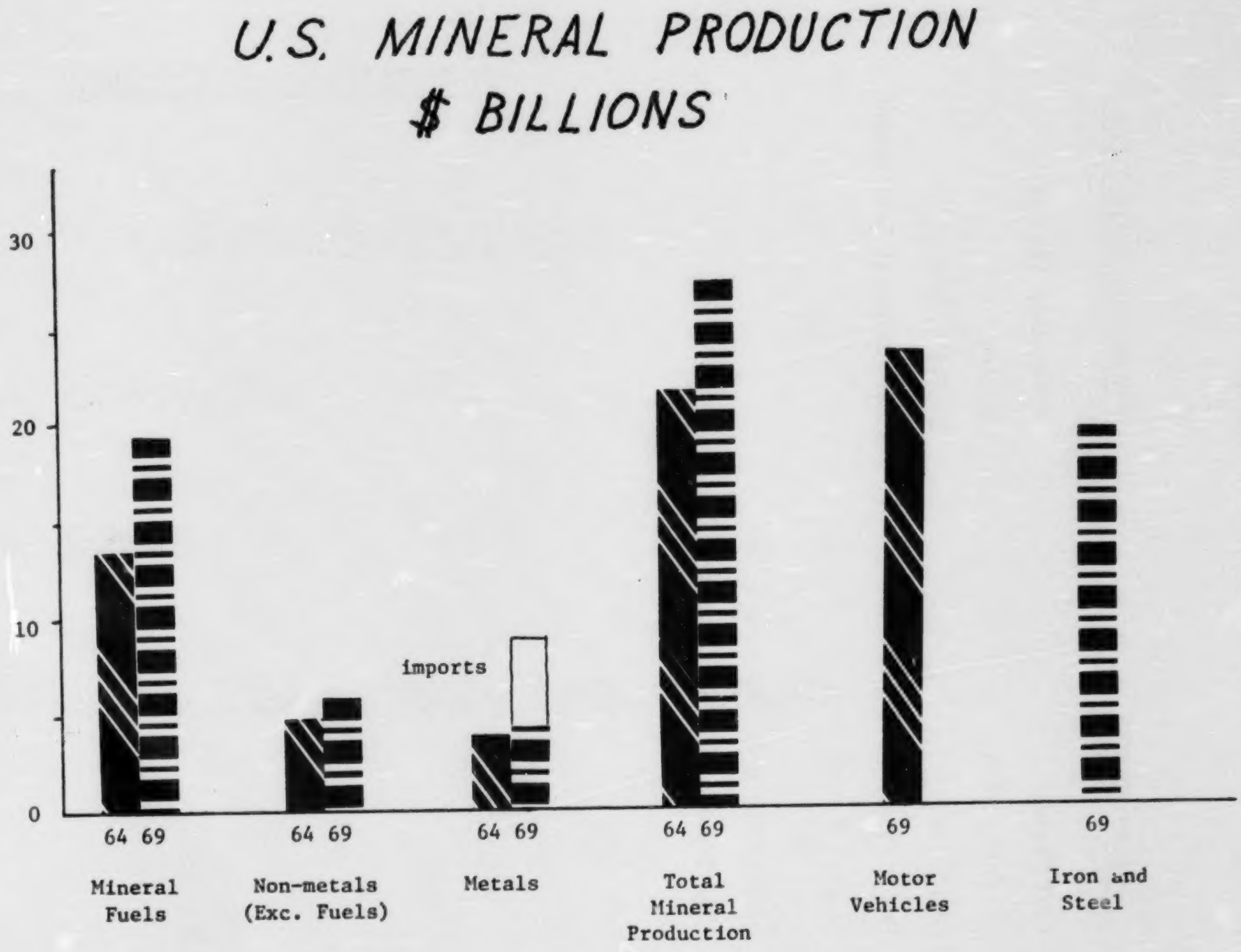
Construction Projects

Dredging

Landfill

Water Resources Development

FIGURE I


U.S. MINERAL PRODUCTION
$ BILLIONS
30
20
10
0
imports
64 69
Mineral Fuels
64 69
Non-metals (Exc. Fuels)
64 69
Metals
64 69
Total Mineral Production
69
Motor Vehicles
69
Iron and Steel

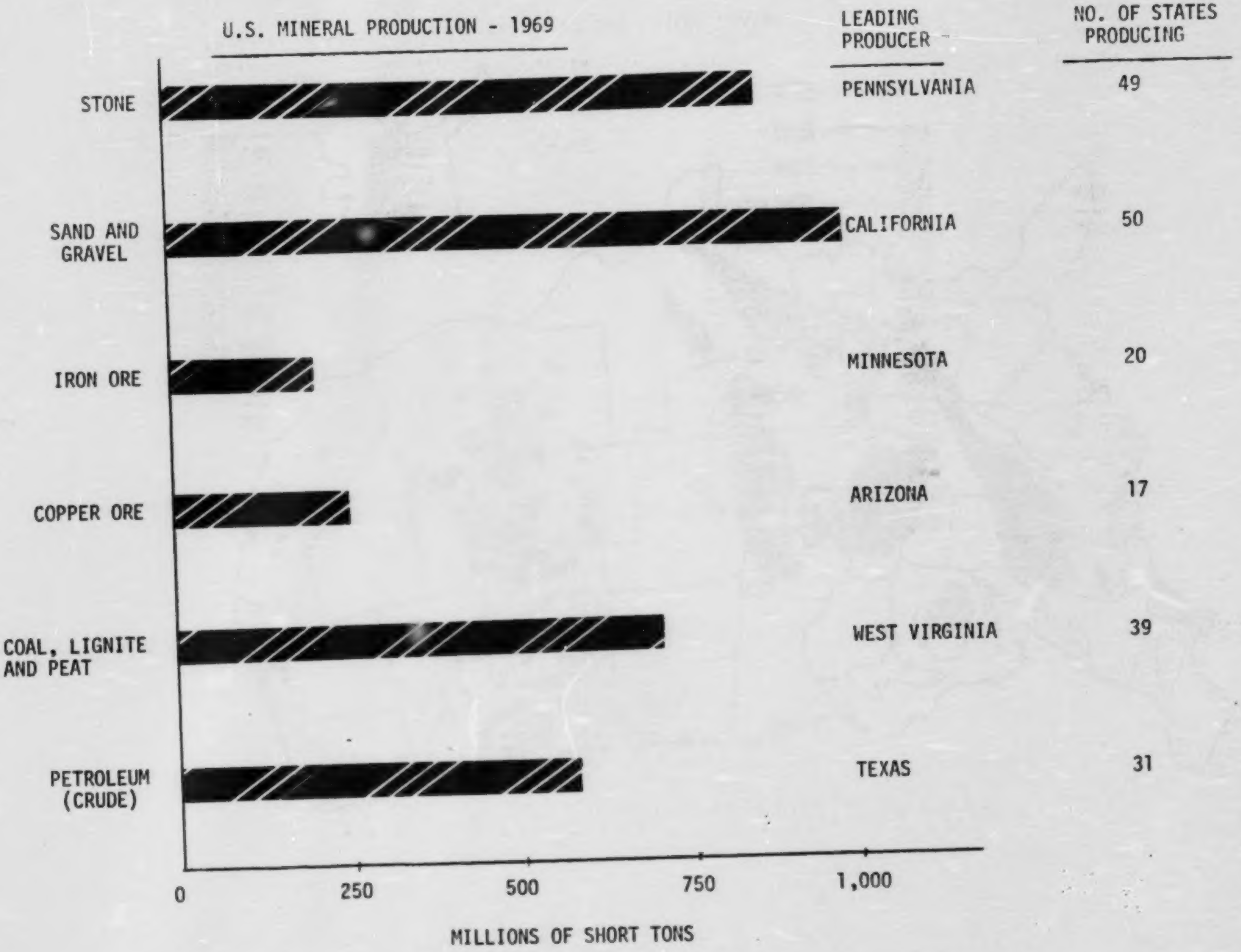
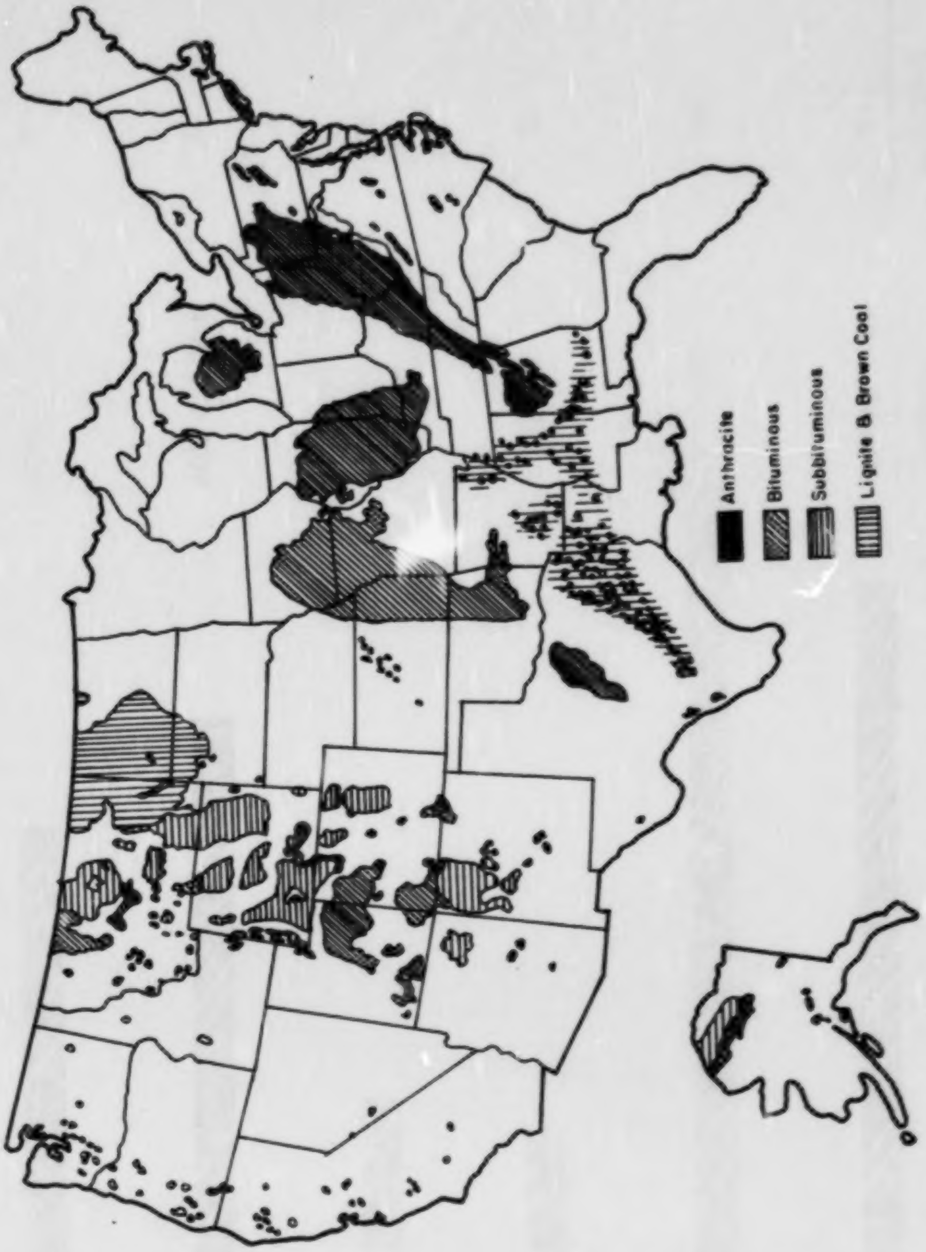

U.S. MINERAL PRODUCTION - 1969
LEADING PRODUCER
NO. OF STATES PRODUCING
STONE
PENNSYLVANIA
49
SAND AND GRAVEL
CALIFORNIA
50
IRON ORE
MINNESOTA
20
COPPER ORE
ARIZONA
17
COAL, LIGNITE AND PEAT
WEST VIRGINIA
39
PETROLEUM (CRUDE)
TEXAS
31
0
250
500
750
1,000
MILLIONS OF SHORT TONS

FIGURE II

FIGURE III


■ Anthracite
▨ Bituminous
▤ Subbituminous
▥ Lignite & Brown Coal

Coal Fields of the United States

TABLE II

PUBLISHED REPORTS

Mining Pollution Control

1401 - Mine Drainage

Report Number	Title/Author	Source
14010---06/70	Oxygenation of Ferrous Iron; by Harvard University, Cambridge, Massachusetts	GPO - $1.75 NTIS - PB 189 233
14010DAY06/71	Inorganic Sulfur Oxidation by Iron-Oxidizing Bacteria; by Syracuse Univ., Syracuse, New York	GPO - $1.25
14010DDH08/71	Control of Mine Drainage from Coal Mine Mineral Wastes - Phase I - Hydrology and Related Experiments; by Truax-Traer Coal Company, Pinckneyville, Illinois	GPO - $1.25 NTIS - PB 206 194
14010DEE12/70	Treatment of Acid Mine Drainage; by Horizons, Inc., Cleveland, Ohio	GPO - $1.00 NTIS - PB 197 470
14010DII05/71	Rotary Precoat Filtration of Sludge from Acid Mine Drainage Neutralization; by Johns-Manville Products Corp., Manville, New Jersey	GPO - $1.25 NTIS - PB 203 190
14010DKM11/70	Microbial Factor in Acid Mine Drainage Formation; by Mellon Institute, Carnegie-Mellon Univ., Pittsburgh, Pennsylvania	GPO - 70¢ NTIS - PB 196 113
14010DLC11/69	Sulfide Treatment of Acid Mine Drainage; by Bituminous Coal Research, Inc., Monroeville, Pennsylvania	NTIS - PB 187 866
14010DLI02/71	Silicate Treatment for Acid Mine Drainage Prevention; by Tyco Laboratories, Inc., Waltham, Massachusetts	GPO - $1.00 NTIS - PB 198 427
14010DMO03/70-A	Investigative Mine Survey of a Small Watershed; by Halliburton Co., Duncan, Oklahoma	GPO - $2.00 NTIS - PB 196 110
14010DMO03/70	New Mine Sealing Techniques for Water Pollution Abatement; by Halliburton Co., Duncan, Oklahoma	GPO - $1.50 NTIS - PB 196 736
14010DRB05/71	Flocculation and Clarification of Mineral Suspensions; by University of Minnesota, Minneapolis, Minnesota	GPO - $1.25 NTIS - PB 206 238
14010DRZ02/71	Purification of Mine Water by Freezing; by Applied Science Laboratories, Inc., State College, Pennsylvania	GPO - 70¢
14010DYG08/71	Acid Mine Waste Treatment Using Reverse Osmosis; by Gulf Environmental Systems Company, San Diego, California	GPO - $1.00 NTIS - PB 202 228

Report Number	Title/Author	Source
14010DYH12/71	Neutradesulfating Treatment Process for Acid Mine Drainage; by Catalytic, Inc., Philadelphia, Pennsylvania	GPO - $1.00
14010DYI02/71	Evaluation of a New Acid Mine Drainage Treatment Process; by Black, Sivalls and Bryson, Inc., Pittsburgh, Pennsylvania	GPO - $1.50 NTIS - PB 202 571
14010DYK03/70	Treatment of Acid Mine Drainage by Reverse Osmosis; by Rex Chainbelt, Inc., for the Commonwealth of Pennsylvania	GPO - 55¢ NTIS - PB 195 200
14010DZM08/70	Feasibility Study of Mining Coal in an Oxygen Free Atmosphere; by Island Creek Coal Co., Holden, WV and Cyrus Wm. Rice Div., NUS Corp., Pittsburgh, Pennsylvania	GPO - $1.50 NTIS - PB 197 446
14010ECC08/71	The Effects of Various Gas Atmospheres on the Oxidation of Coal Mine Pyrites; by Cyrus Wm. Rice Div., NUS Corporation, Pittsburgh, Pennsylvania	GPO - $1.25 NTIS - PB 203 679
14010EFK06/72	Use of Latex as a Soil Sealant to Control Acid Mine Drainage; by Uniroyal, Inc., Wayne, NJ	(At press)
14010EGJ11/69	Effects of Antibacterial Agents on Mine Drainage; by MSA Research Corp. and Pennsylvania Dept. of Mines and Mineral Industries	NTIS - PB 191 215
14010EHN04/71	Detection of Abandoned Underground Coal Mines by Geophysical Methods; by HRB-Singer, Inc., State College, Pennsylvania	GPO - $1.00
14010EIZ01/70	Limestone Treatment of Acid Mine Drainage; by Bituminous Coal Research, Inc., Monroeville, Pennsylvania	GPO - $1.25 NTIS - PB 195 282
14010EIZ12/71	Studies of Limestone Treatment of Acid Mine Drainage - Part II; by Bituminous Coal Research, Inc., Monroeville, Pennsylvania	GPO - $1.25 NTIS - PB 208 326
14010EJE12/71	Mine Spoil Potentials for Water Quality and Controlled Erosion; by College of Agriculture and Forestry, West Virginia University, Morgantown, West Virginia	GPO - $1.75 NTIS - PB 208 817
14010EJT09/71	Studies on Densification of Coal Mine Drainage Sludge; by Bituminous Coal Research, Inc., Monroeville, Pennsylvania	GPO - $1.25 NTIS - PB 203 189
14010EMS09/69	Bulk Transport of Waste Slurries to Inland and Ocean Disposal Sites - Vol. I;	NTIS - PB 189 757
	" " " " - Vol. II;	NTIS - PB 189 758
	" " " " - Vol. III;	NTIS - PB 189 759
14010EMS12/69	" " " " - Summary; by Bechtel Corp., San Francisco, CA	NTIS - PB 189 756
14010ENW09/71	Microbiological Treatment of Acid Mine Drainage Waters; by Continental Oil Co., Ponca City, Oklahoma	GPO - $1.00 NTIS - PB 206 231

Report Number	Title/Author	Source
14010ETV08/70	Neutralization of High Ferric Iron Acid Mine Drainage; by Roger C. Wilmoth and Ronald D. Hill, FWQA, Cincinnati, Ohio	GPO - 50¢ NTIS - PB 192 087
14010EXA03/71	Pilot Scale Study of Acid Mine Drainage; by Ohio State University, Columbus, Ohio	GPO - $1.00
14010FBZ09/71	Concentrated Mine Drainage Disposal Into Sewage Treatment Systems; by Environmental Research & Applications, Inc., Wilton, CT	GPO - 75¢
14010FII03/71	Evaluation of Pyritic Oxidation by Nuclear Methods; by Mellon Insti., Carnegie-Mellon University, Pittsburgh, Pennsylvania	GPO - 50¢ NTIS - PB 198 523
14010FJX12/71	Dewatering of Mine Drainage Sludge; by Coal Research Bureau, West Virginia University, Morgantown, West Virginia	GPO - $1.00 NTIS - PB 208 347
14010FKK12/70	Underground Coal Mining Methods to Abate Water Pollution; by West Virginia Univ., Morgantown, West Virginia	GPO - 60¢
14010FLW07/70	Feasibility Study Manual - Mine Water Pollution Control Demonstrations; by FWQA, Washington, D.C.	GPO - 65¢ NTIS - PB 197 594
14010FMH12/70	Treatment of Acid Mine Drainage by Ozone Oxidation; by Brookhaven National Laboratories, Associated Universities, Inc., Atomic Energy Commission, Upton, New York	GPO - $1.00 NTIS - PB 198 225
14010FNQ02/72	Electrochemical Treatment of Acid Mine Waters; by Tyco Laboratories, Inc., Waltham, Massachusetts	GPO - $1.00 NTIS - PB 208 820
14010FOA02/71	Carbonate Bonding of Coal Refuse; by Black, Sivalls and Bryson, Inc., Pittsburgh, PA	GPO - 60¢ NTIS - PB 198 230
14010FPR04/71	Acid Mine Drainage Formation and Abatement; by Ohio State University Research Foundation, Columbus, Ohio	NTIS - PB 199 835
14010FPS02/70	Sulfide to Sulfate Reaction Mechanism; by Ohio State University Research Foundation, Columbus, Ohio	GPO - $1.50
14010FQR03/72	Reverse Osmosis Demineralization of Acid Mine Drainage; by The Ecology Division, Rex Chainbelt, Inc., Milwaukee, Wisconsin	GPO - $1.00
14010FUI10/71	Foam Separation of Acid Mine Drainage; by Horizons, Inc., Cleveland, Ohio	GPO - 65¢ NTIS - PB 208 411
14010FYY09/71	Study of Sulfur Recovery from Coal Refuse; by Black, Sivalls and Bryson, Inc., Pittsburgh, Pennsylvania	GPO - 70¢ NTIS - PB 203 488
14010FZU03/72	Legal Problems of Coal Mine Reclamation; by University of Maryland School of Law, Baltimore, Maryland	GPO - $2.00 NTIS - PB 209 862
14010HBQ09/71	Feasibility Study Upper Meander Creek Mine Drainage Abatement Project; by Stanley Consultants, Cleveland, Ohio	GPO - 60¢ NTIS - PB 206 232

Report Number	Title/Author	Source
1403 - Oil Shale		
14030EDB12/71	Water Pollution Potential of Spent Oil Shale Residues; by Colorado State Univ., Fort Collins, Colorado	GPO - $1.25 NTIS - PB 206 808
1405 - Phosphate Mining		
14050EPU08/71	Utilization of Phosphate Slime; by International Minerals & Chemical Corporation, Skokie, Illinois	GPO - $1.25 NTIS - PB 203 191
	Other Sources of Pollution Control	
1503 - Construction		
15030DTL05/70	Urban Soil Erosion and Sediment Control; by National Association of Counties Research Foundation, Washington, D.C.	GPO - $1.00 NTIS - PB 196 111
EPA-R2-72-015	Guidelines for Erosion and Sediment Control Planning and Implementation; by The Department of Water Resources, State of Maryland, Annapolis, Maryland and Hittman Associates, Inc., Columbia, Maryland	GPO - $1.75
1504 - Impoundments		
15040EJZ12/70	Selective Withdrawal from a Stratified Reservoir; by University of California, Berkeley, California	GPO - $1.00 NTIS - PB 201 726

TABLE III

FINAL REPORTS BEING WRITTEN

The technical portion of the following projects has been completed, and the final reports will be published shortly.

Project No.	Title
14010 DSC	Evaluation of Pollution Abatement Procedures in the Moraine State Park, Butler Co., Pa.
14010 EAH	Pyritic Systems: A Mathematical Model
14010 EFJ	Study of the Use of In-situ Precipitation of Sludge Resulting from Reaction of Mine Water with Low Cost Additives in an Abandoned Mine to Prevent Mine Drainage Pollution
14010 EFL	Study of the Use of Inert Gas to Eliminate Acid Pollution from Abandoned Deep Mines
14010 EFN	Construction of Mine Water Treatment Plant at Hollywood, Pa.
14010 EKW	Use of Gel Material for Sealing Deep Mine Openings
14010 FMM	Study of the Conversion of Pyrites by Oxidation in Chlorinated Solvents
14010 FNJ	Acid Mine Drainage Treatment by Ion Exchange
14010 FWW	Trough Creek Limestone Barrier Installation and Evaluation
14010 FZF	Conversion of Mine Drainage to Potable Water by Sulfate Cycle Ion Exchange
14010 GYH	Oxidation of Ferrous Iron in Coal Mine Water with Activated Carbon Catalysts
14010 HKN	Acid Mine Drainage Seal Research
14020 DLN	Rehabilitation of a Brine-Polluted Aquifer
14020 EHW	North Fork Alluvial Decontamination Project
14020 FVW	Small Scale Chloride Waste Treatment
14040 FKX	Removal of Dissolved Contaminants from Mine Drainage
14040 FVD	Storage and Disposal of Wastes Resulting from the Concentration of Low Grade Iron Ore
14040 FZC	Abatement of Mine Drainage Pollution from Mines of the Rocky Mountains

II

MINING SOURCES

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ACTIVE PROJECTS

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INFORMATION SHEET

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

This sheet describes briefly a grant under Section 6b
Federal Water Pollution Control Act, As Amended

PROJECT NUMBER: 14010 DAX

TITLE OF PROJECT: "Lime/Limestone Neutralization of Acid Mine Drainage"

GRANTEE:
Peabody Coal Company
301 N. Memorial Drive
St. Louis, Missouri 63102

PROJECT DIRECTOR:
Alten Grandt, General Manager
Landuse & Conservation Dept.
Peabody Coal Company
Farmington, Illinois 61531

Project Site: Carrier Mills, Illinois

SPECIFIC DATA ABOUT THIS AWARD

Award Date: November 6, 1968

Project Cost: $692,000.00

Completion Date: May 6, 1973

Federal Cost: $472,400.00

DESCRIPTION OF PROJECT
This project is for the design, construction and operation of a full scale demonstration plant for the neutralization of acid mine drainage utilizing lime and limestone. Project objectives are to develop techniques to optimize neutralization efficiency, minimize chemical and operating costs and to obtain information for application of this process at other locations.

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INFORMATION SHEET

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

This sheet describes briefly a grant under Section 6b
Federal Water Pollution Control Act, As Amended

PROJECT NUMBER: 14010 DDH

TITLE OF PROJECT: "Demonstration of Control of Acid Drainage from Coal Mine Refuse Piles and Slurry Areas"

GRANTEE:	PROJECT DIRECTOR:
Truax-Traer Coal Company Division of Consolidation Coal Company, Inc. Chicago, Illinois 60602	Gene Long, General Manager Reclamation and Land Use Fiatt, Illinois 61433

Project Site: DuQuoin, Illinois

SPECIFIC DATA ABOUT THIS AWARD

Award Date:	October 31, 1968	Project Cost:	$720,800.00
Completion Date:	November 1, 1970	Federal Cost:	$490,560.00

DESCRIPTION OF PROJECT

This project consists of two phases. Phase I is described in the section on completed projects. This portion, Phase II, will implement specific remedial procedures for the reclamation of coal preparation plant refuse piles and slurry lagoons to eliminate acid drainage. This will be followed by a monitoring program that will determine the degree of pollution abatement.

INFORMATION SHEET

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

This sheet describes briefly a grant under Section 6b
Federal Water Pollution Control Act, As Amended

PROJECT NUMBER: 14010 DSC

TITLE OF PROJECT: "Evaluation of Pollution Abatement Procedures in the Moraine State Park, Butler County, PA.

GRANTEE:
Commonwealth of Pennsylvania
Dept. of Mines & Mineral Ind.
660 Boas Street
Harrisburg, Pennsylvania 17102
Gwin Engineers, Inc.

PROJECT DIRECTOR:
Mr. Donald E. Fowler

Project Site: Butler County, PA

SPECIFIC DATA ABOUT THIS AWARD

Award Date: July 17, 1968

Project Cost: $21,600

Completion Date: July 30, 1971

Federal Cost: $15,120

DESCRIPTION OF PROJECT

This research project will be an evaluation of the various mine drainage pollution abatement projects to be completed during the construction phase of the Moraine State Park, Pennsylvania. The remedial methods include strip mine reclamation, deep mine sealing, grouting, surface sealing, refuse pile removal and oil and gas well plugging. Water quantity and quality measurements will be made throughout the watershed area and an evaluation of this data, supplemented by field examinations and investigations, will serve as the basis for the determination of the relative effectiveness of the pollution abatement procedures. In this study, acidity will be considered to be the major detriment and the comparison of the production in acidity before and after abatement will be used as the principal criteria for evaluation. Other components such as discharge flow rates, pH, alkalinity, iron and manganese will be examined as well as factors affecting erosion and turbidity.

INFORMATION SHEET

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

This sheet describes briefly a grant under Section 6b
Federal Water Pollution Control Act, As Amended

PROJECT NUMBER: 14010 DSD

TITLE OF PROJECT: "Catawisa Creek Mine Drainage Pollution Abatement Project"

GRANTEE:
Commonwealth of Pennsylvania
Dept. of Mine & Mineral Ind.
660 Boas Street
Harrisburg, Pennsylvania 17102

PROJECT DIRECTOR:
Mr. Donald E. Fowler
Division of Developmental Research
Dept. of Environmental Resources
P.O. Box 1467
Harrisburg, Pennsylvania 17120

Project Site: Schuylkill & Luzerne Co. Pa.

SPECIFIC DATA ABOUT THIS AWARD

Award Date:	July 17, 1968	**Project Cost:**	$522,200.00
Completion Date:	March 16, 1973	**Federal Cost:**	$365,540.00

DESCRIPTION OF PROJECT

This project is designed to confirm previous estimates of mine drainage pollution abatement and to evaluate the at-source control method of inundation of a mine by plugging (sealing) three existing drainage tunnels within an isolated pocket of coal. Inundation of the mine will attempt to prevent acid mine drainage formation by displacing the air with water.

INFORMATION SHEET

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

This sheet describes briefly a grant under Section 6b Federal Water Pollution Control Act, As Amended

PROJECT NUMBER: 14010 DZM

TITLE OF PROJECT: "A Demonstration of a New Mining Technique to Prevent the Formation of Mine Acid in an Active Deep Mine"

GRANTEE:

Island Creek Coal Co.
Island Creek Division
Holden, West Virginia 25625

PROJECT DIRECTOR:

R. C. Taliaferro

Project Site: Holden, WVA

SPECIFIC DATA ABOUT THIS AWARD

Award Date: June 30, 1970

Completion Date: October 31, 1972

Project Cost: $831,770

Federal Cost: $582,239

DESCRIPTION OF PROJECT

This project is Phase II of a program to demonstrate that mining coal in an oxygen free atmosphere will prevent the formation and subsequent discharge of mine drainage pollution into streams and other water courses. The objective of Phase II is to test the important systems, especially the life support system, in an active ventilated mine and prepare a detailed design of the demonstration mine including estimated costs of construction and operation.

The Phase I project was a system engineering evaluation that determined the feasibility of mining in an inert gas atmosphere using "space age technology."

This award is for the second year of a project originally obligated August 1, 1969. The total project cost including this award is $932,025.00 and the total Federal cost is $652,417.00.

EPA Hq Form 5330-1 (6-72)

INFORMATION SHEET

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

This sheet describes briefly a contract under Section 6b Federal Water Pollution Control Act, As Amended.

PROJECT NUMBER: 14010 EAH (14-12-589)

TITLE OF PROJECT: "Pyritic Systems: A Mathematical Model"

CONTRACTOR:
The Ohio State University
Research Foundation
1314 Kinnear Road
Columbus, OH 43212

PROJECT DIRECTOR
Prof. Edwin E. Smith
Dept. of Chemical Eng.

Project Site: Columbus, Ohio

SPECIFIC DATA ABOUT THIS AWARD

Award Date: October 29, 1969

Completion Date: January 31, 1972

Project Cost: $68,918

Federal Cost: $68,918

DESCRIPTION OF PROJECT

A mathematical model of a pyritic system will be developed for underground mines to evaluate the interactions of the variables involved in the formation of acid mine water. The model will relate the rate of acid formation to the rate of pollution discharge from the system. The input to the model will be a physical and chemical description of the system, and the output will be estimates of the daily acid load and drainage flow. The model will be developed with the aid of a digital computer and will be verified from data collected at two mine drainage sites.

INFORMATION SHEET

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

This sheet describes briefly a grant under Section 6 b
Federal Water Pollution Control Act, As Amended

PROJECT NUMBER: 14010 EFJ

TITLE OF PROJECT: "Study of the Use of In-situ Precipitation of Sludge Resulting from Reaction of Mine Water with Low Cost Additives in an Abandoned Mine to Prevent Mine Drainage Pollution"

GRANTEE:
Commonwealth of Pennsylvania
Dept. of Mines & Mineral Ind.
660 Boas Street
Harrisburg, Pennsylvania 17102
Parsons-Jurden, Inc.

PROJECT DIRECTOR:
Mr. Donald E. Fowler

Project Site: Elder Township, Cambria County, Pennsylvania

SPECIFIC DATA ABOUT THIS AWARD

Award Date:	June 25, 1968	**Project Cost:**	$325,035.00
Completion Date:	June 30, 1971	**Federal Cost:**	$227,524.00

DESCRIPTION OF PROJECT

This project is intended to demonstrate an in-situ technique for minimizing acid mine drainage. A mixture of neutralizing material such as brine, an inert filler and gelling additives will be injected, as a slurry, into the mine at predetermined intervals. A semi-solid plug will form which will restrict air and water flow through the mine. The material will also neutralize a part of the already formed acid material and coat some of the pyrites.

INFORMATION SHEET

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

This sheet describes briefly a grant under Section 6b
Federal Water Pollution Control Act, As Amended

PROJECT NUMBER: 14010 EFL

TITLE OF PROJECT: "Study of the Use of Inert Gas to Eliminate Acid Pollution From Abandoned Deep Mines"

GRANTEE:
Commonwealth of Pennsylvania
Dept. of Mines & Mineral Ind.
660 Boas Street
Harrisburg, Pennsylvania 17102
C.W. Rice, Div. of NUS Corp.

PROJECT DIRECTOR:
Mr. Donald E. Fowler

Project Site: Ohiopyle State Park, Fayette County, PA.

SPECIFIC DATA ABOUT THIS AWARD

Award Date: June 6, 1968

Project Cost: $172,027

Completion Date: December 31, 1971

Federal Cost: $83,784

DESCRIPTION OF PROJECT

A small drift mine will be sealed, and air-blowing and monitoring equipment installed. The air leak rate from the mine will be determined by correlating variable air input rates to the changes in the barometric pressures and temperatures in the mine.

The initial phase of this study has been completed. The continuation of this project will be concerned with an evaluation of the state-of-the-art of existing technology to locate points of air leakage from deep mines; installation of air seals: and continuation of the original study to pressurize the mine with an inert gas.

EPA Hq Form 5330-1 (6-72)

INFORMATION SHEET

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

This sheet describes briefly a grant under Section 6 b
Federal Water Pollution Control Act, As Amended

PROJECT NUMBER: 14010 EFN

TITLE OF PROJECT: "Construction of Mine Water Treatment Plant at Hollywood, Pennsylvania"

GRANTEE:
Commonwealth of Pennsylvania
Dept. of Mine & Mineral Ind.
660 Boas Street
Harrisburg, Pennsylvania 17102
Pennsylvania State University
Project Site: Hollywood, Pennsylvania

PROJECT DIRECTOR:
Mr. Donald E. Fowler

SPECIFIC DATA ABOUT THIS AWARD

Award Date: March 28, 1968

Completion Date: July 30, 1971

Project Cost: $1,000,000.00

Federal Cost: $700,000.00

DESCRIPTION OF PROJECT

This project is a demonstration of the treatment of acid mine waters by neutralization. Investigations of five basic treatment processes comprise the actual demonstration study in this 500,000 gallon per day plant. These five processes are as follows: (1) flash mixing, aeration and settling; (2) flash mix, aeration, thickening, settling; (3) thickening (with lime), sludge recycle, supernatant discharge; (4) biological oxidation tank, sludge recycle, thickening, limestone reactor, settling; and (5) trickling filter, thickening, limestone reactor, settling.

Construction of this plant has been completed and the plant was dedicated June 27, 1970.

EPA Hq Form 5330-1 (6-72)

INFORMATION SHEET

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

This sheet describes briefly a grant under Section 6b
Federal Water Pollution Control Act, As Amended

PROJECT NUMBER: 14010 EKW

TITLE OF PROJECT: "Use of Gel Material for Sealing Deep Mine Openings"

GRANTEE:
Commonwealth of Pennsylvania
Dept. Of Mines & Mineral Ind.
660 Boas Street
Harrisburg, PA 17102
Dravo Corporation
Project Site: Keystone State Park, PA

PROJECT DIRECTOR:
Mr. Donald E. Fowler

SPECIFIC DATA ABOUT THIS AWARD

Award Date: September 19, 1969

Project Cost: $205,000

Completion Date: March 1, 1972

Federal Cost: $143,500

DESCRIPTION OF PROJECT

This project will demonstrate the sealing of a mine opening with the injection of a polymeric material to form an in-situ seal. This will be done through the drilled hole that locates the mine from the surface. A secondary objective of the project will determine the effect on the ground water of water-sealing of deep mines and creating underground pools. In those instances where the mine has depleted the groundwater, it will be determined whether sealing can reestablish a groundwater table.

INFORMATION SHEET

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

This sheet describes briefly a grant under Section6b Federal Water Pollution Control Act, As Amended

PROJECT NUMBER: 14010 ELB

TITLE OF PROJECT: "Evaluation of Lime-Soda Ash Treatment of Neutralized Mine Drainage"

GRANTEE:
Commonwealth of Pennsylvania
Dept. of Mines & Mineral Ind.
660 Boas Street
Harrisburg, PA. 17102
Gwin, Dobson & Foreman, Inc.

PROJECT DIRECTOR:
Mr. Donald E. Fowler
Division of Developmental Research
Dept. of Environmental Resources
P. O. Box 1467
Harrisburg, PA 17102

Project Site: Altoona, Penna.

SPECIFIC DATA ABOUT THIS AWARD

Award Date: June 18, 1970

Completion Date: February 28, 1973

Project Cost: $2,598,340

Federal Cost: $78,930

DESCRIPTION OF PROJECT

A full scale lime-soda ash treatment process will be applied to each of four different water sources and evaluated to determine the following:

A. Chemical dosages required to yield finished water which will meet specific water use criteria.

B. Operational factors associated with the process.

C. Operation of the process on various feed waters for sufficient time to determine the relevant operating costs and such variables as sludge production and settling rates, ease of continuous operation along with maintenance and labor required.

D. Attempt to evaluate the feasibility and economics of the lime-soda process for municipal and industrial uses on feed waters containing total dissolved solids under 500 mg/l and over 500 mg/l.

The operational systems provided for this experimental work would include a 7.0 MGD capacity for lime neutralization consisting of rapid mixing,slow mixing, aeration and sedimentation. This will be followed by a 3.5 MGD capacity reactor-clarifier for the soda softening process with recarbonation, for this final stage of treatment.

EPA Hq Form 5330-1 (6-72)

INFORMATION SHEET

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

This sheet describes briefly a grant under Section 6b
Federal Water Pollution Control Act, As Amended

PROJECT NUMBER: 14010 FJX

TITLE OF PROJECT: "The Thickening and Dewatering of Precipitates from the Lime/Limestone Treatment of Mine Drainage"

GRANTEE:	PROJECT DIRECTOR:
West Virginia Board of Regents West Virginia University Morgantown, W.VA. 26506	Joseph W. Leonard, Director Coal Research Bureau School of Mines

Project Site: Morgantown, West Virginia

SPECIFIC DATA ABOUT THIS AWARD

Award Date: February 5, 1970	Project Cost: $99,938.40
Completion Date: July 1, 1972	Federal Cost: $69,956.88

DESCRIPTION OF PROJECT

This project will provide the technical information necessary so that: (1) existing knowledge may be properly applied; and, (2) new or conceptual knowledge may be utilized in order to densify the sludge which results from lime or limestone mine water treatment. Knowledge and procedures in the areas of both chemical and mechanical densification will be employed. Broad areas of specialization which are concerned with these techniques include; coagulation, flocculation, decantation, filtration, thickening, centrifuging and cycloning.

A portion of this project has been completed and is described in the section on completed projects.

INFORMATION SHEET

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

This sheet describes briefly a contract under Section 5 Federal Water Pollution Control Act, As Amended.

PROJECT NUMBER: 14010 FMM (14-12-897)

TITLE OF PROJECT: "Study of the Conversion of Pyrites by Oxidation in Chlorinated Solvents"

CONTRACTOR:	PROJECT DIRECTOR
Cyrus Wm. Rice Division NUS Corporation 1910 Cochran Road Pittsburgh, PA 15205	Mr. J. C. Troy Vice President

Project Site: Pittsburgh, PA

SPECIFIC DATA ABOUT THIS AWARD

Award Date: June 21, 1970	Project Cost: $73,810
Completion Date: June 1, 1972	Federal Cost: $73,810

DESCRIPTION OF PROJECT

The project will study the chlorination of pyrites in organic solvents for recovery of iron oxide and sulfur.

Processes have been proposed to recover coal from refuse piles as a means of eliminating the hazard of spontaneous combustion. Such reprocessing will obviously produce a final refuse enriched in pyrites and it has been estimated that the amount of elemental sulfur in coal refuse could be as much as 200 pounds of sulfur per ton of coal produced. A process that could extract sulfur from pyrites might thus combine with a coal extraction process to produce a final refuse that is neither combustible nor capable of causing water pollution. In addition to sulfur recovery, it is possible that a salable iron oxide might further enhance conservation of mineral resources.

INFORMATION SHEET

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

This sheet describes briefly a contract under Section 6b
Federal Water Pollution Control Act, As Amended.

PROJECT NUMBER: 14010 FNJ (14-12-887)

TITLE OF PROJECT: "Acid Mine Drainage Treatment by Ion Exchange"

CONTRACTOR:
Culligan Incorporated
Northbrook, Illinois 60062

PROJECT DIRECTOR
Ed Kreusch

Project Site: Northbrook, Illinois

SPECIFIC DATA ABOUT THIS AWARD

Award Date: June 29, 1970

Completion Date: June 30, 1972

Project Cost: $88,483

Federal Cost: $88,483

DESCRIPTION OF PROJECT

This project is to study several different ion exchange processes under identical laboratory conditions and establish the operating characteristics of the ion exchange systems. Performance characteristics of the resins will be used to predict full scale plant performance and to estimate the operating cost for complete plants to treat acid mine drainage by several different ion exchange processes.

EPA Hq Form 5330-2 (6-72)

INFORMATION SHEET

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

This sheet describes briefly a grant under Section 6b
Federal Water Pollution Control Act, As Amended

PROJECT NUMBER: 14010 FWW

TITLE OF PROJECT: "Trough Creek Limestone Barrier Installation and Evaluation"

GRANTEE:
Commonwealth of Pennsylvania
Dept. of Mines & Mineral Ind.
660 Boas Street
Harrisburg, Pennsylvania 17102

PROJECT DIRECTOR:
Mr. Donald E. Fowler
Division of Developmental Research
Department of Environmental Resources
P.O. Box 1467
Harrisburg, Pennsylvania 17120

Project Site: Trough Creek, Pennsylvania

SPECIFIC DATA ABOUT THIS AWARD

Award Date: June 22, 1970

Completion Date: January 22, 1973

Project Cost: $224,660.00

Federal Cost: $28,160.00

DESCRIPTION OF PROJECT

Limestone barriers have been constructed at six locations in the Trough Creek Watershed for the purpose of eliminating mine drainage pollution of Trough Creek. An investigation and evaluation of the effectiveness of the barriers will be undertaken. This will include: analysis of selected samples of limestone that will be tagged and placed within the barriers; chemical analysis of the stream and flow gauging; and evaluation of hydraulic design and recommendation for improvement.

INFORMATION SHEET

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

This sheet describes briefly a contract under Section 6b *Federal Water Pollution Control Act, As Amended.*

PROJECT NUMBER: 14010 FZF (68-01-0043)

TITLE OF PROJECT: "Conversion of Mine Drainage to Potable Water by Sulfate Cycle Ion Exchange"

CONTRACTOR:	PROJECT DIRECTOR
Aqua-Ion Corporation P. O. Box 276 Point Richmond, California	J. Benjamin Stark

Project Site: Point Richmond, California

SPECIFIC DATA ABOUT THIS AWARD

Award Date: February 25, 1971	Project Cost: $70,265
Completion Date: February 24, 1972	Federal Cost: $70,265

DESCRIPTION OF PROJECT

Mine waters neutralized by calcium carbonate will be filtered through a new, patented filter to remove all suspended solids and the effluent passed through an anion exchange system to convert the water to a weak solution of calcium hydroxide. Regeneration of the resin by a saturated lime solution will cause the precipitation of calcium sulfate which will be removed by filtration. This filtrate will be recycled to the resin.

The weak solution of calcium hydroxide will be carbonated to precipitate calcium carbonate. The precipitate will be removed by filtration resulting in a sediment-free, high quality water suitable for municipal or industrial use.

INFORMATION SHEET

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

This sheet describes briefly a grant under Section 6b
Federal Water Pollution Control Act, As Amended

PROJECT NUMBER: 14010 GAO

TITLE OF PROJECT: "Electrochemical Removal of Heavy Metals from Acid Mine Drainage"

GRANTEE:
Commonwealth of Pennsylvania
Department of Mines & Mineral Industries
660 Boas Street
Harrisburg, Pennsylvania 17102

PROJECT DIRECTOR:
Mr. Donald E. Fowler
Division of Developmental Research
Department of Environmental Resources
P.O. Box 1467
Harrisburg, Pennsylvania 17120

Project Site: Harrisburg, Pennsylvania

SPECIFIC DATA ABOUT THIS AWARD

Award Date:	June 3, 1971	Project Cost:	$127,786.00
Completion Date:	October 1, 1972	Federal Cost:	$89,457.00

DESCRIPTION OF PROJECT

This project is for the study of the oxidation of ferrous iron to ferric iron by means of a fluidized bed. The bed is an inert matrix, between two electrodes, and since the particles are conductive the ends of each particle facing their particular cathodes or anodes exhibit the corresponding characteristics. The particles themselves are bipolar. In this fluidized bed, intimate contact is provided which minimizes the contact time required for the oxidation to proceed, and also reduces the inherent characteristic of the reaction to decrease its rate as the concentration of ion decreases. The project will be carried out in two phases, a laboratory phase and a field phase involving approximately 15,000 gallons per day unit.

INFORMATION SHEET

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

This sheet describes briefly a grant under Section 6b
Federal Water Pollution Control Act, As Amended

PROJECT NUMBER: 14010 GCM

TITLE OF PROJECT: "Evaluation of Millers Run and Campbells Run Mine Drainage Pollution Abatement"

GRANTEE:	PROJECT DIRECTOR:
Commonwealth of Pennsylvania Dept. of Mines & Mineral Ind. 660 Boas Street Harrisburg, Pennsylvania 17102	Mr. Donald E. Fowler Division of Developmental Research Department of Environmental Resources P.O. Box 1467 Harrisburg, Pennsylvania 17120

Project Site: Allegheny County, Pennsylvania

SPECIFIC DATA ABOUT THIS AWARD

Award Date:	November 6, 1970	Project Cost:	$615,317.00
Completion Date:	August 31, 1973	Federal Cost:	$49,748.00

DESCRIPTION OF PROJECT

The objective of this project is to evaluate the effectiveness of abatement procedures for acid mine drainage which are to be applied to the Millers Run and Campbells Run areas of the Chartiers Drainage Basin. Monitoring will be done at 15 sampling stations to provide information for preliminary evaluations and conclusions for presentation in quarterly reports during the three year period. This information will include stream flow and water quality as well as the status of the construction work in the survey areas. The final report will include conclusions and recommendations for the use of these construction techniques on future acid mine drainage abatement projects.

INFORMATION SHEET

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

This sheet describes briefly a grant under Section 5
Federal Water Pollution Control Act, As Amended

PROJECT NUMBER: 14010 GSI

TITLE OF PROJECT: "Studies on the Removal of Manganese from Mine Drainage"

GRANTEE:

Wilkes College
Wilkes-Barre, PA. 18703

PROJECT DIRECTOR:

Dr. Ralph B. Rozelle
Wilkes College
Wilkes-Barre, PA 18703

Project Site: Wilkes-Barre, Pennsylvania

SPECIFIC DATA ABOUT THIS AWARD

Award Date: May 7, 1971

Completion Date: May 31, 1972

Project Cost: $17,357

Federal Cost: $16,489

DESCRIPTION OF PROJECT

The first phase was a study of the reaction of manganese with strong oxidizing agents such as ozone or chlorine to determine the rates and efficiencies of the reactions. The study was carried out in the low, middle, and high pH ranges (ca. 3 to 10).

A study of the economic of treatment of mines waters for removal of manganese will be undertaken.

Phase II involving additional work on oxidation reactions using ozone will be carried out during 1972 and 1973.

INFORMATION SHEET

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

This sheet describes briefly a grant under Section 6b
Federal Water Pollution Control Act, As Amended

PROJECT NUMBER: 14010 GYH

TITLE OF PROJECT: "Oxidation of Ferrous Iron in Coal Mine Water with Activated Carbon Catalysts"

GRANTEE:	PROJECT DIRECTOR:
Bituminous Coal Research, Inc. 350 Hochberg Road Monroeville, PA 15146	James F. Boyer, Jr.

Project Site: Pittsburgh, PA.

SPECIFIC DATA ABOUT THIS AWARD

Award Date: May 18, 1971	Project Cost: $71,140
Completion Date: May 31, 1972	Federal Cost: $49,800

DESCRIPTION OF PROJECT

This project will delineate the process variables influencing the catalytic oxidation of ferrous iron with activated carbon as well as the types of coal mine water to which this process is applicable. The effects of type, size consists, amount, and surface area of several commercially available carbons, as well as aeration rate on oxidation will be studied. The rate of oxidation employing activated carbons in mine water will be compared with the same systems containing no activated carbon. The mechanism by which the carbon catalysts become activated after an induction period will be examined with emphasis on the changing nature of the carbon. The presence or absence of specific iron or sulfur oxidizing bacteria in the carbons will be determined, and if either of these bacteria are present, the experiment will be repeated using sterilized chemicals, carbon, mine water and air to compare this to the other experiments where bacteria were present.

EPA Hq Form 5330-1 (6-72)

INFORMATION SHEET

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

This sheet describes briefly a contract under Section 5 *Federal Water Pollution Control Act, As Amended.*

PROJECT NUMBER: 14010 HED (68-01-0078)

TITLE OF PROJECT: "Pilot Plant Purification of Acid Mine Drainage by Reverse Osmosis"

CONTRACTOR: West Virginia University Morgantown, West Virginia	PROJECT DIRECTOR Dr. G. Lansing Blackshaw West Virginia University Morgantown, West Virginia

Project Site: Morgantown, West Virginia

SPECIFIC DATA ABOUT THIS AWARD

Award Date: June 25, 1971	Project Cost: $185,619
Completion Date: Oct. 24, 1972	Federal Cost: $185,619

DESCRIPTION OF PROJECT

This project is for the development of necessary engineering data on the neutralosis process. This process involves the use of reverse osmosis to purify acid mine drainage, and subsequent neutralization of the concentrated brine. The supernatant liquor from the neutralized brine is totally recycled into the reverse osmosis unit thus giving an overall process which has two effluents, a very high grade water and an innocuous, neutral sludge. This project will investigate the use of this process on ferrous waters and upon water containing both ferrous and ferric ions.

This project will provide answers to such research problems as, (1) what is the maximum iron concentration which may be present in a feed water, (2) what is the maximum calcium sulfate concentration that may be present in the feed water, (3) what is the maximum total dissolved solids which may be present in water used in this unit, (4) what is the maximum suspended solids which may be present in the feed without plugging the membrane, (5) what is the highest percentage of product water recovery obtainable under various conditions, (6) what are the estimated economics of this system when used for each of these different kinds of waters?

The first years work involved the design and construction of a test facility and purchase of the reverse osmosis unit. The second year will involve actual experimentation.

EPA Hq Form 5330-2 (6-72)

INFORMATION SHEET

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

This sheet describes briefly a grant under Section 14
Federal Water Pollution Control Act, As Amended

PROJECT NUMBER: 14010 HHG

TITLE OF PROJECT: "Demonstration of the Technique of Water Infiltration Control To Achieve Mine Water Pollution Control"

GRANTEE:	**PROJECT DIRECTOR:**
Department of Natural Resources State of West Virginia 1800 Washington Street, East Charleston, West Virginia 25305	Mr. Edgar N. Henry, Chief, Water Resources Division

Project Site: Morgantown, West Virginia

SPECIFIC DATA ABOUT THIS AWARD

Award Date: June 22, 1971	**Project Cost:** $961,392.00
Completion Date: December 31, 1974	**Federal Cost:** $672,000.00

DESCRIPTION OF PROJECT

The objective of this multi-phased project is to demonstrate water infiltration control to prevent mine water pollution by reclaiming surface mined areas, thus preventing surface water from entering adjacent deep mines. A detailed feasibility study (Phase I) revealed that the Dents Run watershed near Morgantown, West Virginia would be amenable for demonstrating this method of mine drainage pollution control. This feasibility study will be published in the near future.

Monitoring of the water quality and quantity before, during and after construction together with keeping detailed construction cost records will enable the engineering and economic feasibility and practicality of the abatement technique to be ascertained.

INFORMATION SHEET

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

This sheet describes briefly a grant under Section 14
Federal Water Pollution Control Act, As Amended

PROJECT NUMBER: 14010 HIN

TITLE OF PROJECT: "Tioga River Mine Drainage Pollution Abatement Project"

GRANTEE:
Commonwealth of Pennsylvania
Dept. of Environmental Resources
P.O. Box 1467
Harrisburg, Pennsylvania 17120

PROJECT DIRECTOR:
Mr. Donald E. Fowler
Division of Developmental Research
Department of Environmental Resources
Harrisburg, Pennsylvania 17120

Project Site: Morris Run, Pennsylvania

SPECIFIC DATA ABOUT THIS AWARD

Award Date: June 17, 1971

Project Cost: $676,500.00

Completion Date: August 31, 1974

Federal Cost: $450,000.00

DESCRIPTION OF PROJECT

The primary objective of this multi-phased project is to demonstrate effectiveness of certain construction techniques for abatement and/or reduction of acid mine drainage (AMD) resulting from past unregulated surface and underground coal mining. Techniques to be demonstrated include: restoration of strip pits and the use of varying amounts of agricultural limestone, and digested primary and secondary sewage sludges as soil conditioners thereon; burying of acid forming materials within strip pits; stream channel reconstruction and lining; and restoration and/or grouting of subsidence areas.

The project work will include initial establishment of a gauging, sampling and analytical program to be carried out during the life of the project. Accurate cost records will be kept and monitoring of mine drainage discharges and receiving streams will continue during construction and after construction has been completed so that effectiveness of the techniques can be demonstrated and documented.

EPA Hq Form 5330-1 (6-72)

INFORMATION SHEET

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

This sheet describes briefly a grant under Section 6(b)
Federal Water Pollution Control Act, As Amended

PROJECT NUMBER: 14010 HIQ

TITLE OF PROJECT: "Mine Spoil Potentials for Soil & Water Quality"

GRANTEE:	**PROJECT DIRECTOR:**
West Virginia University Morgantown, West Virginia	Dr. Richard M. Smith Division of Plant Sciences

Project Site: Morgantown, West Virginia

SPECIFIC DATA ABOUT THIS AWARD

Award Date: July 1, 1971	**Project Cost:** $215,878
Completion Date: June 30, 1973	**Federal Cost:** $99,903

DESCRIPTION OF PROJECT

The purpose of this study is to assure that variable earth materials in surface mine spoils and mine slags are placed and treated appropriately for prevention of water pollution and development of desirable soils and landscapes. This will be accomplished by: (1) Identifying, correlating, describing and sampling soil and rock strata in regions where surface mining is in progress or planned; (2) Determining chemical, physical and mineralogical properties of soil, rock, mine spoil and mine slag samples involved in water quality problems; (3) Determining natural or induces weathering processes and rates for earth materials in known or controlled environments; (4) Determining interactions among spoils, ammendments, plants (including microbes) and water over both short and long time intervals.

Major emphasis will be placed upon refining methods used to classify the pollution potential of overburden material representative of the Appalachian Region and to apply these methods at a few selected field sites by analyzing the overburden prior to mining, recommending appropriate reclamation procedures and determining the effectiveness of these procedures.

INFORMATION SHEET

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

This sheet describes briefly a grant under Section 14
Federal Water Pollution Control Act, As Amended

PROJECT NUMBER: 14010 HJQ

TITLE OF PROJECT: "Lake Hope Mine Drainage Demonstration Project"

GRANTEE:
State of Ohio
Dept. of Natural Resources
Columbia, Ohio 43215

PROJECT DIRECTOR:
Mr. S.L. Frost

Project Site: Zaleski, Ohio

SPECIFIC DATA ABOUT THIS AWARD

Award Date: June 25, 1971

Project Cost: $1,320,131.50

Completion Date: October 1, 1974

Federal Cost: $808,000.00

DESCRIPTION OF PROJECT

The Lake Hope project will demonstrate the control and elimination of mine drainage pollution by refuse pile disposal and/or covering and underground mine sealing. Acid producing coal refuse will be removed and buried in suitably prepared sites. These sites will be finished graded and seeded. Non-acid producing coal mine refuse piles will be reshaped to existing contours, covered and reclaimed by appropriate seeding and tree planting for erosion control and aesthetic enhancement. The mine sealing demonstration program will be undertaken in two phases. The first phase will seal those mine openings which have been determined the most significant acid discharges and those openings immediately adjacent to or suspected of having connections with the high acid concentration discharge openings. The second phase will seal selected remaining mine openings as determined by the continuous water quality monitoring data obtained. Continuous water quality monitoring systems will obtain data to be evaluated over the life of the project and after all construction has been completed.

INFORMATION SHEET

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

This sheet describes briefly a contract under Section 6b
Federal Water Pollution Control Act, As Amended.

PROJECT NUMBER: 14010 HKN (68-01-0135)

TITLE OF PROJECT: "Acid Mine Drainage Seal Research"

CONTRACTOR:	PROJECT DIRECTOR
NUS - D'Appolonia (Joint Venture) 1910 Cochran Road Pittsburgh, PA 15220	J. C. Troy Cyrus Wm. Rice Div. NUS Corp. 1910 Cochran Road Pittsburgh, PA 15220

Project Site: Pittsburgh, PA

SPECIFIC DATA ABOUT THIS AWARD

Award Date: June 30, 1971	Project Cost: $162,976
Completion Date: October 31, 1972	Federal Cost: $162,976

DESCRIPTION OF PROJECT

This project is designed to explore and amplify information gained on a previous research project relating to the design, installation and testing of permeable mine seals. These seals are expected to be low cost, effective and long lasting plugs which will restrain most of the mine waters which formerly escaped from the mine opening. Those waters which do escape through this permeable plug, shall be treated by the chemicals in the plug, such as limestone, so that the waters are neutral, contain little in the way of heavy metals and will provide for the growth of fish and aquatic vegetation.

Due to the composition of the permeable plug, it is expected that dissolved minerals, such as iron sulfates shall be precipitated and as such, increase the effectiveness of the seal. This is essentially a self sealing plug in that small defects in the seal shall be corrected via the precipitation of iron hydroxides as the mine water is neutralized.

This contract is specifically aimed at the study of various materials of construction such as, size of the matrix materials, size consist, and additives such as cement, refuse, organic polymers and fly ash in order to provide for the specific design information necessary for optimum field installation and testing.

INFORMATION SHEET

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

This sheet describes briefly a grant under Section 14
Federal Water Pollution Control Act, As Amended

PROJECT NUMBER: 14010 HNS

TITLE OF PROJECT: "Demonstration of the Technique of Reuse of Treated Active Surface Mine Drainage for Revegetation Augmentation"

GRANTEE:
Commonwealth of Kentucky
Department of Natural Resources
Division of Reclamation
209 St. Clair Street
Frankfort, Kentucky 40601
Project Site: Madisonville, Kentucky

PROJECT DIRECTOR:
Mr. Robert C. Nickel
Program Coordinator

SPECIFIC DATA ABOUT THIS AWARD

Award Date: June 16, 1971
Project Cost: $460,098.00
Completion Date: Dec. 31, 1974
Federal Cost: $332,068.00

DESCRIPTION OF PROJECT

The project will demonstrate at two active surface mines the technique of using neutralized acid mine drainage to irrigate new vegetative cover on regraded spoil banks in order to achieve higher vegetative survival and to eliminate pollution of surface water courses. Hydrated lime will be used at one site and pulverized limestone at the other. Commercially available neutralization modules will be used.

Both sites are active surface mines with mine pit floors below the local water table. The discharge water enters the pits from groundwater and spoil bank runoff, with substantially all other surface water being diverted. Site discharge flows vary between 100,000 and 500,000 gpd. These sites lie in Muhlenberg and Hopkins Counties in the Western Coal Field of Kentucky near Madisonville.

INFORMATION SHEET

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

This sheet describes briefly a contract under Section 6b
Federal Water Pollution Control Act, As Amended.

PROJECT NUMBER: 14010 HTV (68-01-0716)

TITLE OF PROJECT: "High Expansion Foams as a Method of Inerting Abandoned Coal Mine Areas"

CONTRACTOR:	PROJECT DIRECTOR
Mine Safety Appliance Co. MSA Research Corporation Evans City, Pennsylvania 16033	Ralph Hiltz

Project Site: Evans City, Pennsylvania

SPECIFIC DATA ABOUT THIS AWARD

Award Date: June 29, 1972	Project Cost: $56,870
Completion Date: February 28, 1974	Federal Cost: $56,870

DESCRIPTION OF PROJECT

This project is to evaluate the utilization of high expansion foams as a sealing and inerting mechanism for worked out areas of coal mines to prevent the formation and discharge of acid water. This will include a determination of the current state of the art of all expanded foams for use in underground mines, a laboratory investigation of the gel rates, foam collapse rates, adhesion characteristics, expansion rates, water head, solubility, cell structure and other characteristics of high expansion foam necessary for the application of these foams in underground mines.

The project will attempt sealing of an underground room in a mine with a foam that will completely fill the void spaces. This room will be completely isolated from the main mine area by means of appropriate stippings. An additional room will have the ribs and roof sealed with foam in an attempt to eliminate or prevent contact of air and water with the acid producing material. This room will also be isolated from the main portion of the mine with stoppings. Continuous monitoring of the water quality and quantity from the area will be made to determine whether an air seal has been maintained in the rooms by the use of the foams applied.

INFORMATION SHEET

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

This sheet describes briefly a grant under Section 5
Federal Water Pollution Control Act, As Amended

PROJECT NUMBER: 14020 DLN

TITLE OF PROJECT: "Rehabilitation of a Brine-Polluted Aquifer"

GRANTEE:
Arkansas Soil & Water
Conservation Commission
151 State Capital
Little Rock, Arkansas 72201

PROJECT DIRECTOR:
Mr. G. J. Stramel

Project Site: Garland City, Arkansas

SPECIFIC DATA ABOUT THIS AWARD

Award Date: April 1, 1969

Completion Date: April 1, 1972

Project Cost: $40,741

Federal Cost: $26,271

DESCRIPTION OF PROJECT

This two-year project will be executed in cooperation with the Arkansas Water Pollution control Commission, and will demonstrate the restoration of the quality of a producing groundwater aquifer which has been polluted by seepage of oil-field brine through an evaporation pit (an unlined earthen pit) and later a faulty disposal well.

The brine contaminated zone within the aquifer will be accurately located by exploratory wells and then withdrawn by a series of carefully placed and operated production wells. This withdrawal will cause a rapid influx of fresh water to restore the quality of the groundwater in the area. It is estimated that this artificial flushing of the aquifer can restore the water to usable quality in about two years, about fifty times as fast as through natural flushing processes.

INFORMATION SHEET

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

This sheet describes briefly a grant under Section 6b
Federal Water Pollution Control Act, As Amended

PROJECT NUMBER: 14020 EHW

TITLE OF PROJECT: "North Fork Alluvial Decontamination Project"

GRANTEE: West Central Texas Municipal Water District Box 2362 Abilene, Texas 79604	**PROJECT DIRECTOR:** Mr. Victor Jaeggli

Project Site: Abilene, Texas

SPECIFIC DATA ABOUT THIS AWARD

Award Date: May 10, 1968	**Project Cost:** $272,323.00
Completion Date: August 31, 1972	**Federal Cost:** $184,816.00

DESCRIPTION OF PROJECT

This project will demonstrate an actual clean-up of contaminated surface waters using the deep well disposal technique. Abatement of surface water pollution due to oil production brine waste seepage into streams from polluted alluvial waters will be accomplished by pumping the brine out of shallow aquifers and injecting it into deep saline aquifers for permanent disposal. A reservoir which had been contaminated by the brine flow will be monitored to document the effects of such remedial action.

EPA Hq Form 5330-1 (6-72)

INFORMATION SHEET

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

This sheet describes briefly a contract under Section 5 Federal Water Pollution Control Act, As Amended.

PROJECT NUMBER: 14020 FVW (14-12-873)

TITLE OF PROJECT: "Small Scale Chloride Waste Treatment"

CONTRACTOR:	PROJECT DIRECTOR
University of Oklahoma Research Institute Norman, Oklahoma 73069	Professor George W. Reid

Project Site: Norman, Oklahoma

SPECIFIC DATA ABOUT THIS AWARD

Award Date: June 24, 1970	Project Cost: $29,835.00
Completion Date: Nov. 23, 1971	Federal Cost: $29,835.00

DESCRIPTION OF PROJECT

The project will investigate and evaluate methods of brine control applicable to small localized oil production, select applicable design criteria, and prepare a manual entitled, "Brine Control for Small Scale Operators." Emphasis will be on water pollution aspects detailing the various procedures which may be available to minimize or prevent water pollution, as well as areas requiring additional study.

Specifically the objectives of the project are economic, technical and institutional (legal) appraisal of disposal techniques available to the small operator. Selection of promising design criteria and specifications will be based on (a) transportation, (b) injection, (c) solar evaporation, and (d) desalination. Likelihood of system failure and procedural techniques will be considered.

INFORMATION SHEET

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

This sheet describes briefly a grant under Section 5
Federal Water Pollution Control Act, As Amended

PROJECT NUMBER: 14040 FKX

TITLE OF PROJECT: "Removal of Dissolved Contaminants from Mine Drainage"

GRANTEE:	**PROJECT DIRECTOR:**
University of Utah Salt Lake City, Utah 84112	Dr. Jan D. Miller Dept. of Metallurgy

Project Site: Salt Lake City, Utah

SPECIFIC DATA ABOUT THIS AWARD

Award Date: May 14, 1970

Project Cost: $21,351

Completion Date: November 31, 1971

Federal Cost: $20,246

DESCRIPTION OF PROJECT

This project will attempt to demonstrate that undesirable metal contaminants in mine drainage effluents may be absorbed on siliceous mill tailings which are generally available near the mine site. Experiments will be conducted in single element systems with selective types of mill tailings to determine absorption efficiency and capacity. Elements to be studied are: iron, aluminum, copper, lead and manganese. Absorptive experiments will also be conducted with actual mine drainage at the mill sites.

Metal ion removal from tailings (which will have been loaded with ions as described above) will be studied as a function of volume of water and pH. In addition, experiments will also be conducted by contacting the loaded tailings with water for a period of time and cycling through air drying.

INFORMATION SHEET

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

This sheet describes briefly a grant under Section 6b
Federal Water Pollution Control Act, As Amended

PROJECT NUMBER: 14040 FVD

TITLE OF PROJECT: "Storage and Disposal of Wastes Resulting from the Concentration of Low Grade Iron Ore"

GRANTEE:	**PROJECT DIRECTOR:**
Michigan Technological Univ.	Dr. G.R. Alger
Houghton, Michigan 49931	Civil Engineering Department

Project Site: Houghton, Michigan

SPECIFIC DATA ABOUT THIS AWARD

Award Date:	May 15, 1970	**Project Cost:**	$73,603.00
Completion Date:	September 15, 1971	**Federal Cost:**	$45,603.00

DESCRIPTION OF PROJECT

The overall objective of the proposed project is to improve the applied technology related to the storage, disposal, and reuse of water resulting from the beneficiation of low grade iron ore, and specifically:

(1) To develop basin design and management criteria which recognize the influence of tailings settleability as well as the effects of hydrologic phenomena on pond effluent quality.

(2) To investigate the physical and transport characteristics of the supra-colloidal particles contained in the tailings basin discharge with a view toward predicting the rate at which these particles might be removed from a natural water system.

(3) To investigate alternative tertiary treatment methods for eliminating the fine particulate materials from the basin discharge with a view toward developing a tertiary treatment system for subsequent demonstrations.

Hq Form 5330-1 (6-72)

INFORMATION SHEET

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

This sheet describes briefly a grant under Section 5
Federal Water Pollution Control Act, As Amended

PROJECT NUMBER: 14040 FZC

TITLE OF PROJECT: "Abatement of Mine Drainage Pollution from Mines of the Rocky Mountains"

GRANTEE:	**PROJECT DIRECTOR:**
Colorado Seminary University of Denver University Park Denver, Colorado 80210	Dr. L.W. Ross Department of Chemical Engineering

Project Site: Denver, Colorado

SPECIFIC DATA ABOUT THIS AWARD

Award Date:	June 10, 1970	Project Cost:	$22,465.00
Completion Date:	August 31, 1971	Federal Cost:	$21,340.00

DESCRIPTION OF PROJECT

This project is to study the abatement of acid mine drainage originating from metal (hard rock) mining in the Rocky Mountains. Techniques developed in the Applachia regions and those necessary to remove those metals unique to this region will be investigated. These metal ions would be precipitated by an alkaline sulfide added to the stream after pH adjustment. Emphasis will be placed on economic considerations including treatment costs and possible marketability of the metal sludges.

Hq Form 5330-1 (6-72)

INFORMATION SHEET

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

This sheet describes briefly a contract under Section 6 b *Federal Water Pollution Control Act, As Amended.*

PROJECT NUMBER: 800290 (68-01-0195)

TITLE OF PROJECT: "Study of the Carbonate Bonding Process with Taconite Tailings"

CONTRACTOR:
Applied Technology Corporation
135 Delta Drive
Pittsburgh, Penna. 15238

PROJECT DIRECTOR
Dr. P. J. LaRosa

Project Site: Pittsburgh, Pennsylvania

SPECIFIC DATA ABOUT THIS AWARD

Award Date: April 24, 1972

Project Cost: $18,914

Completion Date: October 24, 1972

Federal Cost: $18,914

DESCRIPTION OF PROJECT

This is a feasibility study on the validity and utility of the carbonate process, previously developed for use with coal refuse, on taconite tailing. Previous work has indicated that a mixture of lime and refuse, when thoroughly compacted, and treated with carbon monoxide gas, results in a hard, durable, compression resistant matrix which may have utility in construction and road building. This project is to widen our knowledge of this new process and determine if the process is as useful for taconite tailings as it is for coal mine refuse. Both of these refuse materials have a wide potential for creating water pollution. This program is part of an effort to inhibit the formation of such pollution through the use of the materials in other markets. The new matrix could be a valuable by-product from a useless, pollution causing agent.

INFORMATION SHEET

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

This sheet describes briefly a grant under Section 14
Federal Water Pollution Control Act, As Amended

PROJECT NUMBER: 801273

TITLE OF PROJECT: "Elk Creek Demonstration Project"

GRANTEE:	PROJECT DIRECTOR:
West Virginia Dept. of Natural Resources 1800 Washington Street, East Charleston, West Virginia 25311	Mr. Edgar N. Henry Chief, Division of Water Resources

Project Site: Elk Creek Watershed, Harrison & Barbour Counties, W. VA.

SPECIFIC DATA ABOUT THIS AWARD

Award Date:	June 28, 1972	Project Cost:	$641,115.00
Completion Date:	June 14, 1975	Federal Cost:	$448,700.00

DESCRIPTION OF PROJECT

The objective of the project is to demonstrate the effectiveness of three at-source mine drainage pollution control methods at abandoned surface and deep mine sites. The three methods are: impermeable slurry trench, deep mine roof collapse, and regrading alkaline spoil material.

The project will consist of four phases. Phase I is a detailed feasibility study; Phase II is preparation of detailed plans and specifications; Phase III is construction of the abatement facilities; and Phase IV is monitoring and preparation of the final report. The final report will include all pertinent project data and the evaluation of the effectiveness of each of the three methods.

EPA Hq Form 5330-1 (6-72)

INFORMATION SHEET

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

This sheet describes briefly a grant under Section 14
Federal Water Pollution Control Act, As Amended

PROJECT NUMBER: S-801276

TITLE OF PROJECT: "Demonstration of Debris Basins for Control of Surface Mine Sedimentation in Steep Slope Terrain"

GRANTEE:

Commonwealth of Kentucky
Dept. of Natural Resources
Division of Reclamation
209 St. Clair Street
Frankfort, Kentucky 40601

PROJECT DIRECTOR:

Mr. Robert E. Nickel

Project Site: Breathitt, Knott & Pike Counties, Kentucky

SPECIFIC DATA ABOUT THIS AWARD

Award Date: June 27, 1972

Project Cost: $327,551

Completion Date: May 31, 1976

Federal Cost: $229,058

DESCRIPTION OF PROJECT

The objective of the project is to demonstrate the effectiveness of debris basins to control sediment discharges from surface mining operations in steep slope terrain. These basins will be constructed in accordance with present rules, regulations and legislative requirements under actual working methods as currently practiced in the eastern Kentucky coal fields.

The project will consist of five phases. Phase I - will be a detailed feasibility study, Phase II - will be for engineering (surveying, mapping and design review), Phase III - will be the actual mining operations, Phase IV - will be for monitoring and Phase V - will be for the preparation of the Final Report. The Final Report will include all pertinent project data and the evaluation and effectiveness of the demonstration program.

INFORMATION SHEET

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

This sheet describes briefly a grant under Section 14
Federal Water Pollution Control Act, As Amended

PROJECT NUMBER: 801353

TITLE OF PROJECT: "Deer Park Daylighting Project"

GRANTEE:
State of Maryland
Dept. of Water Resources
State Office Building
Annapolis, Maryland 21401

PROJECT DIRECTOR:
John Matis
Geologist

Project Site: Deer Park, Maryland

SPECIFIC DATA ABOUT THIS AWARD

Award Date: June 30, 1972

Project Cost: $858,347

Completion Date: June 14, 1976

Federal Cost: $550,000

DESCRIPTION OF PROJECT

The purpose of this project is to demonstrate the effectiveness of daylighting as a procedure for acid mine drainage pollution abatement while providing adequate land reclamation to the immediate and adjacent surface land area. As the secondary objective the project will demonstrate the effectiveness of erosion and sediment control in preventing stream pollution and siltation during and following active surface mining.

The project is divided into five phases. Phase I - is the indepth feasibility study, Phase II - is the engineering design, Phase III - is the construction (actual mining operation), Phase IV - is the Final Report. The Final Report shall include all pertinent project data and the evaluation and effectiveness of the demonstration project.

INFORMATION SHEET

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

This sheet describes briefly a contract under Section 6b
Federal Water Pollution Control Act, As Amended.

PROJECT NUMBER: 68-01-0724

TITLE OF PROJECT: "Resources Allocation to Optimize Mining Pollution Abatement Programs"

CONTRACTOR:
The Ohio State University
Research Foundation
1314 Kinnear Road
Columbus, Ohio 43212

PROJECT DIRECTOR
Mr. K.S. Shumate

Project Site: Columbus, Ohio

SPECIFIC DATA ABOUT THIS AWARD

Award Date: June 29, 1972

Project Cost: $70,423.00

Completion Date: June 28, 1973

Federal Cost: $70,423.00

DESCRIPTION OF PROJECT

This project is to design a computer assisted system to allocate resources to optimize mine drainage pollution abatement programs for all types of active and inactive mines. The basic objective of such abatement programs shall be to achieve the greatest water quality improvement in a basin for a given quantity of resources. The following will be included as elements in the system: (a) the latest abatement technology, (b) associated levels of cost and effectiveness, and (c) basin hydrology and water quality. The computer-assisted system developed, while using existing relevant data, shall be flexible enough to allow the incorporation of new data as it becomes available.

INFORMATION SHEET

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

This sheet describes briefly a contract under Section
Federal Water Pollution Control Act, As Amended.

PROJECT NUMBER: 63-01-0763

TITLE OF PROJECT: "Feasibility Study of a New Surface Mining Method"

CONTRACTOR:
Potomac Engineering &
Surveying
P. O. Box 336
Petersburg, WVA

PROJECT DIRECTOR
Mr. H. F. Moomau

Project Site: Petersburg, WVA

SPECIFIC DATA ABOUT THIS AWARD

Award Date: August 18, 1972
Project Cost: $38,021

Completion Date: February 18, 1972
Federal Cost: $38,021

DESCRIPTION OF PROJECT

This project is to determine the feasibility of a new concept in mining shallow cover coal called "longwall stripping." Longwall stripping is utilizing underground longwall mining technology to recover coal presently being surface mined but without the environmental destruction often associated with "strip mines." Should the project determine the feasibility of this mining concept, several sites will be recommended where a mine could be developed to demonstrate longwall stripping.

III

MINING SOURCES

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COMPLETED PROJECTS

INFORMATION SHEET

This sheet describes briefly a

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

Completed under the provisions of the

Federal Water Pollution Control Act, As Amended.

PROJECT NUMBER: 14010 ____ (PH36-66-107)

TITLE OF PROJECT: "Oxygenation of Ferrous Iron: The Rate-Determining Step in the Formation of Acidic Mine Drainage"

GRANTEE OR CONTRACTOR:
Harvard University
Cambridge, Massachusetts

PROJECT DIRECTOR:
Dr. Werner Stumm

SPECIFIC DATA ABOUT THE PROJECT

Total Project Cost:	$39,734.00	Obligation Date:	April 1, 1966
Total Federal Cost:	$39,734.00	Completion Date:	June 1969

FINAL REPORT:

TITLE: OXYGENATION OF FERROUS IRON
(14010 ____ 6/69)

Author

Abstract

An account of the equilibrium and kinetic relationships which describe and control the distribution and activity of aqueous iron in natural waters is reported. Special emphasis is placed on the kinetics of oxygenation of iron (II), its application to deferrization processes, and its involvement in the formation of acidic coal mine drainage.

The equilibrium relationships which govern the solubilities of ferrous and ferric iron are considered. Included is a redetermination of the solubility product of ferrous carbonate and an estimate of the stability constant for a possible bicarbonato-complex of Fe(II).

The kinetics of the oxygenation of ferrous iron are discussed in both neutral and acidic systems. The rate of oxygenation of ferrous iron over the entire pH range of interest in natural water is described.

Copies available from the Government Printing Office, Washington, D.C. 20402, at $1.75 each.

EPA Hq Form 5330-3 (6-72)

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INFORMATION SHEET

This sheet describes briefly a

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

Completed under the provisions of the

Federal Water Pollution Control Act, As Amended.

PROJECT NUMBER: 14010 DAY

TITLE OF PROJECT: "Inorganic Sulfur Oxidation by Iron-Oxidizing Bacteria"

GRANTEE OR CONTRACTOR:	PROJECT DIRECTOR:
Syracuse University Research Institute Syracuse, N. Y. 13210	Donald G. Lundgren Professor of Microbiology

SPECIFIC DATA ABOUT THE PROJECT

Total Project Cost:	$117,575	**Obligation Date:**	August 7, 1968
Total Federal Cost:	$98,450	**Completion Date:**	August 6, 1971

FINAL REPORT:

TITLE: "INORGANIC SULFUR OXIDATION BY IRON-OXIDIZING BACTERIA" (14010 DAY 06/71)

Author

Abstract

The utilization of sulfur and reduced sulfur compounds by the iron-oxidizing chemolithotroph Thiobacillus ferrooxidans was studied at the biochemical level. The identifications, characterization and partial purification of the rhodanese and sulfite oxidase enzymes completed the scheme of sulfur metabolism in T. ferrooxidans which leads to energy generation.

The effects of organic carbon and energy sources on chemolithotrophic microorganisms were studied. T. ferrooxidans can convert from chemolithotrophic to heterotrophic metabolism after a long lag in the presence of the organic substrate, and after some energy is stored from iron oxidation. Growth on glucose proceeds much like other heterotrophic gram negative organisms. The metabolism of glucose is via the Entner-Doudoroff pathway.

Copies available from the Government Printing Office, Washington, D. C. 20402, at $1.25 each.

EPA Hq Form 5330-3 (6-72)

INFORMATION SHEET

This sheet describes briefly a

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

Completed under the provisions of the

Federal Water Pollution Control Act, As Amended.

PROJECT NUMBER: 14010 DDH

TITLE OF PROJECT: "Demonstration of Control of Acid Mine Drainage from Coal Mine Refuse Piles and Slurry Areas"

GRANTEE OR CONTRACTOR:
Midwestern Division
Consolidation Coal Co., Inc.
Chicago, Illinois 60602

PROJECT DIRECTOR:
Mr. John Ramsey
Library, Pennsylvania 15129

SPECIFIC DATA ABOUT THE PROJECT

Total Project Cost:	$720,800	Obligation Date:	October 31, 1968
Total Federal Cost:	$490,560	Completion Date:	June 1972

FINAL REPORT:

TITLE: "CONTROL OF MINE DRAINAGE FROM COAL MINE WASTES"

Author

Abstract

A project has been underway since 1968, at an abandoned mine located in Southern Illinois, attempting to demonstrate practical means of abating pollution from coal mine mineral wastes. The site included a refuse pile occupying approximately 40 acres and a slurry lagoon complex of 50 acres.

The project consists of two phases. This report, which covers Phase I, describes the characteristics and acid formation rate of the refuse pile. The average rate of acid formation for this refuse pile is 198 pounds of acidity, as $CaCO_3$, per acre per day. Acid contribution from the slurry lagoons was not determined but appears to be negligible.

As an abatement measure, a number of experimental vegetative covers were tested. Grass was successfully established with and without the use of topsoil, weathering well for one year. The long-term effects of establishing a grass cover directly on the refuse without the use of topsoil are not known at this time.

INFORMATION SHEET

This sheet describes briefly a

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

Completed under the provisions of the

Federal Water Pollution Control Act, As Amended.

PROJECT NUMBER: 14010 DEE (14-12-496)

TITLE OF PROJECT: "Treatment of Acid Mine Drainage"

GRANTEE OR CONTRACTOR:	PROJECT DIRECTOR:
Horizons Inc.	Dr. Selwyn Rose
2905 East 79th	Department Head
Cleveland, Ohio 44104	Inorganic Chemistry Dept.

SPECIFIC DATA ABOUT THE PROJECT

Total Project Cost:	$49,300	Obligation Date:	February 28, 1969
Total Federal Cost:	$49,300	Completion Date:	February 27, 1970

FINAL REPORT:

TITLE: "TREATMENT OF ACID MINE DRAINAGE BY FOAM SEPARATION"
(14010 DEE 12/70)

Author

Abstract

Basic experiments were conducted to establish the feasibility of foam fractionation in the treatment of acid coal mine drainage for the removal of the metal ions iron, calcium, manganese and magnesium. The independent variables controlling foam separation of metal ions were determined to be concentration ratio of surfactant to iron, air volume throughput, foam drainage time, total dissolved salt content and type of surfactant used.

The major part of iron, calcium, manganese and magnesium can be foam separated from acid solution by proper control of the independent variables. Foam separation was tested on acid drainage, partially lime neutralized drainage and complete limestone neutralized drainage. Tests on model solutions indicate that treatment of raw acid drainage is most feasible at present. Operating and capital costs are estimated for 0.1 and 1.0 MGD batch treatment plants.

Copies available from the Government Printing Office, Washington, D.C. 20402, at $1.00 each.

INFORMATION SHEET

This sheet describes briefly a

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

Completed under the provisions of the

Federal Water Pollution Control Act, As Amended.

PROJECT NUMBER: 14010 DII

TITLE OF PROJECT: "Neutralization and Precoat Filtration of Concentrated Sludges from Mine Water"

GRANTEE OR CONTRACTOR:
Commonwealth of Pennsylvania
Dept. of Mines & Mineral Ind.
660 Boas Street
Harrisburg, Pennsylvania 17102

PROJECT DIRECTOR:
Dr. David Maneval

SPECIFIC DATA ABOUT THE PROJECT

Total Project Cost: $100,770

Obligation Date: September 11, 1969

Total Federal Cost: $70,539

Completion Date: August 31, 1970

FINAL REPORT:

TITLE: "ROTARY PRECOAT FILTRATION OF SLUDGE FROM ACID MINE DRAINAGE"
(14010 DII 05/71)

Author

Abstract

Rotary vacuum precoat filtration was investigated as a means for dewatering sludge produced by the neutralization of mine drainage at four locations in Pennsylvania during 1969 and 1970.

The process used at these sites consisted of neutralization, aeration, sedimentation, and filtration. The alkalies investigated were limestone, limestone with hydrated lime, calcined magnesite, partially and fully calcined dolomite, and hydrated lime. Filter aids tested included HYFLO^{R} SUPER-CEL^{R}, CELITE^{R} 501, CELITE 503, and CELITE 545. Work at the first three locations indicated that limestone and hydrated lime were the preferred alkalies and that CELITE 501 was the preferred filter aid.

A more extensive program was conducted at the fourth site. A 27 run factorial experiment was conducted investigating the effects of flow rate, limestone feed level, aeration level, and sludge recirculation on equipment operation and on process cost. The significant variables affecting process cost were found to be sludge solids content, the filtration rate, and sludge recirculation. A detailed economic analysis of the process is included in the report.

INFORMATION SHEET

This sheet describes briefly a

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

Completed under the provisions of the

Federal Water Pollution Control Act, As Amended.

PROJECT NUMBER: 14010 DJL (14-12-404)

TITLE OF PROJECT: "The Use of Inert Gases to Eliminate Pollution from Abandoned Mines"

GRANTEE OR CONTRACTOR:	PROJECT DIRECTOR:
Cyrus Wm. Rice Division NUS Manor Oak Two 1910 Cochran Rd. Pittsburgh, PA 15220	Dr. Henry C. Braner Vice President

SPECIFIC DATA ABOUT THE PROJECT

Total Project Cost: $19,689	Obligation Date: June 17, 1968
Total Federal Cost: $19,689	Completion Date: April 1969

FINAL REPORT:

TITLE: "REPORT ON STUDIES OF THE EFFECT OF GAS ATMOSPHERES ON PYRITE OXIDATION (14010 DJL 04/69)

Author

Abstract

Experiments were conducted to study oxidation of coal mine pyrite under various gas atmospheres (air, nitrogen, nitrogen mixtures with carbon dioxide, ammonia and chlorine). In a nitrogen atmosphere, or on switching to nitrogen from air, the discharge quality markedly improved although oxidation products still appeared in the effluent streams. A substantial reduction in sulfate produced in the discharge when air was excluded was observed.

Continuation of this study is EPA Project 14010 ECC, for which a final report is available, and which includes both studies.

INFORMATION SHEET

This sheet describes briefly a

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

Completed under the provisions of the

Federal Water Pollution Control Act, As Amended.

PROJECT NUMBER: 14010 DKN

TITLE OF PROJECT: "Acid Mine Drainage - Pilot Plant Evaluation"

GRANTEE OR CONTRACTOR:	PROJECT DIRECTOR:
Carnegie-Mellon University 4400 Fifth Avenue Pittsburgh, Pennsylvania 15213	Robert A. Baker Carnegie-Mellon University

SPECIFIC DATA ABOUT THE PROJECT

Total Project Cost: $63,910	Obligation Date: January 8, 1969
Total Federal Cost: $57,518	Completion Date: June 30, 1970

FINAL REPORT:

TITLE: "MICROBIAL FACTOR IN ACID MINE DRAINAGE" (14010 DKN 11/70)

Author

Abstract

The role of chemoautotrophic organisms (Ferrobacillus ferrooxidans, Ferrobacillus sulfooxidans and Thiobacillus thiooxidans) in the formation of acid mine drainage from pyritic materials associated with coal mining has been investigated by pilot plant techniques. Dynamic flow, controlled environment units which served as models of mines were used.

It was demonstrated that the concentration of acidity, ferrous and total iron and sulfate in effluent from aerobic, biologically-seeded or unseeded pyritic beds is zero order with respect to flow, except at low flow rates where mass transport is diffusion limited. Algal growth occurred in the acidic, aerobic environment but did not affect acid production.

Acid mine drainage release (a) was not significantly affected by seeding with the individual or a mixture of the three organisms; (b) increased directly with recycle ratios up to 4:1 of forward flow rate; (c) increased appreciably under forced aeration; and, (d) is directly related to available pyritic surface area.

INFORMATION SHEET

This sheet describes briefly a

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

Completed under the provisions of the

Federal Water Pollution Control Act, As Amended.

PROJECT NUMBER: 14010 DLC

TITLE OF PROJECT: "Sulfide Treatment of Acid Mine Drainage"

GRANTEE OR CONTRACTOR:	PROJECT DIRECTOR:
Bituminous Coal Research, Inc. 350 Hochberg Road Monroeville, Pennsylvania 15146	Dr. Richard A. Glenn Manager, Chemical Division

SPECIFIC DATA ABOUT THE PROJECT

Total Project Cost: $77,690	Obligation Date: August 12, 1968
Total Federal Cost: $54,380	Completion Date: November, 1969

FINAL REPORT:

TITLE: "SULFIDE TREATMENT OF ACID MINE DRAINAGE" (14010 DLC 11/69)

Author

Abstract

This project was a laboratory study of the "LHS" process, the combined addition of limestone and hydrogen sulfide to precipitate iron sulfides from coal mine drainage. The unstable nature of the sulfide sludge, possibility of poly-sulfide formation during treatment, instability of mine waters of the type amenable to treatment, and inadequacies of available gas metering equipment are among the factors which militate against the controlled regulation of hydrogen sulfide feed necessary for successful operation of the process. These factors plus a cost evaluation, concluded that the "LHS" process is less attractive than other mine drainage treatment methods.

Copies available from the National Technical Information Services, Springfield, Virginia 22151, $6.00 for PB 187 866

EPA Hq Form 5330-3 (6-72)

INFORMATION SHEET

This sheet describes briefly a

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

Completed under the provisions of the

Federal Water Pollution Control Act, As Amended.

PROJECT NUMBER: 14010 DLI (14-12-560)

TITLE OF PROJECT: "Silicate Treatment of Acid Mine Wastes"

GRANTEE OR CONTRACTOR:	PROJECT DIRECTOR:
Tyco Laboratories, Inc. Corporate Research Division Bear Hill Waltham, Mass. 02154	Raymond Jasinski, Head New Technology Department

SPECIFIC DATA ABOUT THE PROJECT

Total Project Cost: $55,412	Obligation Date: June 24, 1969
Total Federal Cost: $55,412	Completion Date: April 30, 1970

FINAL REPORT:

TITLE: "SILICATE TREATMENT FOR ACID MINE DRAINAGE PREVENTION"
(14010 DLI 02/71)

Author

Abstract

A gel treatment technique has been demonstrated on a laboratory scale which inhibits or prevents the generation of acid mine water from waste coal refuse.

Comparison of the effluent water with an untreated pile shows that the neutralized pile was effective for a minimum of 120 in. of equivalent rainfall in inhibiting AMD generation. The surface gel was effective for a longer period of time. The most effective treatment utilized a mixed alumina/silica gel formed within the pile at depths up to 6 in. This method was effective for more than 500 in. of equivalent rainfall, the duration of the test, and appeared to be exceptionally stable at that time.

Copies available from the Government Printing Office, Washington, D. C. 20402, at $1.00 each.

INFORMATION SHEET

This sheet describes briefly a

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

Completed under the provisions of the

Federal Water Pollution Control Act, As Amended.

PROJECT NUMBER: 14010 DMO (14-12-153)

TITLE OF PROJECT: "Research, Development and Field Testing of Mine Water Pollution Abatement Methods"

GRANTEE OR CONTRACTOR:	**PROJECT DIRECTOR**:
Halliburton Company P. O. Box 1431 Duncan, OK 73533	Alan A. Baker Halliburton Company 608 Hawley Building Wheeling, W. VA.

SPECIFIC DATA ABOUT THE PROJECT

Total Project Cost: $328,830

Obligation Date: July 15, 1968

Total Federal Cost: $328,830

Completion Date: March, 1970

FINAL REPORT:

TITLE: "NEW MINE SEALING TECHNIQUES FOR WATER POLLUTION ABATEMENT" (14010 DMO 03/70)

Author

Abstract

This project developed and field tested new concepts for watertight mine seal and bulkhead construction applicable to abatement of acid mine water pollution. Laboratory research determined proper materials, equipment and techniques for constructing mine seals or bulkheads. Two new processes were developed. One involved a technique of placing a plug of graded limestone aggregate in a mine drift or portal to neutralize any acid mine water discharge until a seal was effected. In the process, precipitation of iron hydroxide gradually closed the pores. The second process consisted of remotely constructing a mine seal including rear and front bulkheads of a self-supporting, quick-setting sodium silicate cement specifically developed for this application. Field testing in West Virginia substantiated the feasibility of both processes when two aggregate and two bulkhead type seals were placed in abandoned mines. Cost of the seals are reported.

Copies available from the Government Printing Office, Washington, D. C. 20402, at $1.50 each.

INFORMATION SHEET

This sheet describes briefly a

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

Completed under the provisions of the

Federal Water Pollution Control Act, As Amended.

PROJECT NUMBER: 14010 DMO (14-12-153)

TITLE OF PROJECT: "Research, Development and Field Testing of Mine Water Pollution Abatement Methods"

GRANTEE OR CONTRACTOR:
Halliburton Company
P.O. Box 1431
Duncan, Oklahoma 73533

PROJECT DIRECTOR:
Alan A. Baker
Halliburton Company
608 Hawley Building
Wheeling, West Virginia

SPECIFIC DATA ABOUT THE PROJECT

Total Project Cost: $328,830.00

Obligation Date: July 15, 1968

Total Federal Cost: $328,830.00

Completion Date: March 1970

FINAL REPORT:

TITLE: INVESTIGATIVE MINE SURVEY OF A SMALL WATERSHED (14010 DMO 3/70-A)

Author

Abstract

An investigation was conducted to locate hidden or unknown drift mine openings in the Browns Creek Watershed in Harrison County, West Virginia. Thirty unknown openings were discovered in an initial reconnaissance. Additional probing using power driven augers was not successful and was deemed impractical. Three specific areas within the watershed were selected for further scrutiny. The bottom of the highwall line in the strip mined area was determined by land surveyors and this information was plotted on old mine maps to indicate the intersection of the stripping with underground mining. A minimum of 107 mine drifts were shown to be exposed by the 14,500 feet of high wall surveyed in the three areas.

Copies available from the Government Printing Office, Washington, D. C. 20402, at $2.00 each.

INFORMATION SHEET

This sheet describes briefly a

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

Completed under the provisions of the

Federal Water Pollution Control Act, As Amended.

PROJECT NUMBER: 14010 DRB

TITLE OF PROJECT: "Flocculation & Clarification of Mineral Suspensions"

GRANTEE OR CONTRACTOR:	PROJECT DIRECTOR:
University of Minnesota Minneapolis, Minnesota 55455	Dr. Iwao Iwasaki Mines Experiment Station

SPECIFIC DATA ABOUT THE PROJECT

Total Project Cost:	$23,723	Obligation Date:	March 6, 1970
Total Federal Cost:	$20,782	Completion Date:	January 6, 1971

FINAL REPORT:

TITLE: FLOCCULATION AND CLARIFICATION OF MINERAL SUSPENSIONS (14010 DRB 5/71)

Author

Abstract

A study of the flocculation and clarification of quartz and goethite suspensions using starch and calcium chloride as flocculants was made by determining the settling rates of the suspensions, the amount of suspended solids in the supernatant liquid, and the concentrations of the residual starch and calcium ion. These determinations, supplemented with measurements of streaming potential, adsorption density, and viscosity, were used to formulate a comprehensive expression of the mechanism involved in the use of starch flocculants. Quartz suspensions, particularly when aged in alkaline solutions, were extremely difficult to clarify. A cationic starch of a certain molecular size and degree of substitution or a combination of a polymeric compound and a cation capable of reversing the charge of the quartz showed some promise in the clarification of quartz suspensions.

Copies available from the Government Printing Office, Washington, D.C. 20402, at $1.25 each.

INFORMATION SHEET

This sheet describes briefly a

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

Completed under the provisions of the

Federal Water Pollution Control Act, As Amended.

PROJECT NUMBER: 14010 DRZ

TITLE OF PROJECT: "Feasibility of the Purification of Acid Mine Water by a Partial Freezing Process"

GRANTEE OR CONTRACTOR:
Commonwealth of Pennsylvania
Dept. of Mines & Mineral Ind.
660 Boas Street
Harrisburg, Pennsylvania 17120
Applied Science Laboratories

PROJECT DIRECTOR:
Dr. David Maneval, Director
of Research & Development

SPECIFIC DATA ABOUT THE PROJECT

Total Project Cost:	$15,000	Obligation Date:	July 17, 1968
Total Federal Cost:	$10,500	Completion Date:	December 31, 1969

FINAL REPORT:

TITLE: "FEASIBILITY OF PURIFICATION OF MINE WATER BY FREEZING PROCESS"
(14010 DRZ 2/71)

Author

Abstract

Acid mine water was subjected to partial freezing to the extent of up to about 50% conversion to ice. It was found that the percent reduction of various metal and acid components in the product water was consistently in the general neighborhood of 85 to 90% but some individual components were reduced up to 98% in some cases.

Similar percent reduction of metal ions was observed in similar freezing experiments using acid mine water that had been treated with lime. Reduction in hardness of this lime-treated water was found to be nearly 100% and the pH to remain substantially unchanged.

With reasonable efforts toward good control and reproducibility of operation, there were still considerable variations. Difficulties with analytical results prevent a firm conclusion as to reduction of sulfate, and leave some uncertainty as to individual metals.

Copies available from the Government Printing Office, Washington, D.C. 20402, at $.70 each.

INFORMATION SHEET

This sheet describes briefly a

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

Completed under the provisions of the

Federal Water Pollution Control Act, As Amended.

PROJECT NUMBER: 14010 DOY

TITLE OF PROJECT: "Design for Acid Mine Drainage Treatment Plant of Norton, West Virginia"

GRANTEE OR CONTRACTOR:

Ruble & Kaple, Incorporated
217 S. Lake Avenue
Duluth, Minnesota 55802

PROJECT DIRECTOR:

Glenn L. Enavold

SPECIFIC DATA ABOUT THE PROJECT

Total Project Cost: $4,708.00

Obligation Date: November 19, 1968

Total Federal Cost: $4,708.00

Completion Date: February 17, 1969

FINAL REPORT:

TITLE:

Author

Abstract

This was a service contract with a consulting engineering firm for the design of a twin lime/limestone acid mine drainage neutralization treatment facility at the Environmental Protection Agency's Norton, West Virginia field station. Upon completion of the project, the cost of constructing the treatment plant by this design was deemed excessive and an alternate in-house design was developed and used. No final report is available.

INFORMATION SHEET

This sheet describes briefly a

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

Completed under the provisions of the

Federal Water Pollution Control Act, As Amended.

PROJECT NUMBER: 14010 DTC

TITLE OF PROJECT: "Microbial Mediation in Generation of Acid Mines Wastes"

GRANTEE OR CONTRACTOR:
President & Fellows of
Harvard College
1350 Massachusetts Ave.
Cambridge, Mass. 02138

PROJECT DIRECTOR:
Dr. Warner Stumm
Professor of Applied Chemistry

SPECIFIC DATA ABOUT THE PROJECT

Total Project Cost: $27,018

Obligation Date: June 10, 1969

Total Federal Cost: $25,667

Completion Date: September 30, 1970

FINAL REPORT:

TITLE:

Author

Abstract

The study was intended to determine the origin and role of autotrophic bacteria in acid mine water. A field method, using radioactive carbon, was to be developed to measure the synthetic activity of autotrophic iron bacteria in situ. A comparison of mine waters which differ in the rate of acidity production was to be made in an attempt to elucidate the chemical and biological factors responsible for these differences. These and other factors were to be evaluated with regard to possible control of microbial activity and in turn of acid mine water generation.

Only one of the proposed areas of study was investigated and no meaningful results were reported. A final report of this project will not be published.

INFORMATION SHEET

This sheet describes briefly a

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

Completed under the provisions of the

Federal Water Pollution Control Act, As Amended.

PROJECT NUMBER: 14010 DYG (14-12-525)

TITLE OF PROJECT: "Acid Mine Waste Treatment Utilizing a Reverse Osmosis Pilot Plant"

GRANTEE OR CONTRACTOR:	PROJECT DIRECTOR:
Gulf General Atomic, Inc. P.O. Box 608 San Diego, California 92112	Dr. Seymour S. Kremen

SPECIFIC DATA ABOUT THE PROJECT

Total Project Cost:	$106,500.00	Obligation Date:	April 7, 1969
Total Federal Cost:	$106,500.00	Completion Date:	October 6, 1970

FINAL REPORT:

TITLE: ACID MINE WASTE TREATMENT USING REVERSE OSMOSIS (14010 DYG 8/71)

Author

Abstract

Two reverse osmosis test units were operated during the course of this project: a nominal 10,000-gpd unit equipped with eighteen 50-ft^2 modules and a nominal 4,000-gpd unit equipped with nine 50-ft^2 modules. The modules used in these units consisted of both high-selectivity and high-flux cellulose acetate membranes.

The test program was carried out at three different mine drainage sites. The mine drainage water at the first site, Norton, West Virginia, contained greater than 98 percent of the iron present in the ferric form; at the other two sites, Morgantown, West Virginia, and Ebensburg, Pennsylvania, the drainage water contained predominantly ferrous iron. Discharges at the second site were so concentrated that recoveries were limited to 50 percent; recoveries of 80 to 90 percent were attained at the first and third sites. No iron fouling was encountered at any of the three sites. Specific salt rejections were >97 percent at all sites.

Copies available from the Government Printing Office, Washington, D. C. 20402, at $1.00 each.

INFORMATION SHEET

This sheet describes briefly a

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

Completed under the provisions of the

Federal Water Pollution Control Act, As Amended.

PROJECT NUMBER: 14010 DYH (14-12-518)

TITLE OF PROJECT: "Treatment of Acid Mine Drainage"

GRANTEE OR CONTRACTOR:
Catalytic Construction Co.
1528 Walnut Street
Philadelphia, Pennsylvania 19102

PROJECT DIRECTOR:
John F. Gilmore, Sr.

SPECIFIC DATA ABOUT THE PROJECT

Total Project Cost:	$327,629	Obligation Date:	April 7, 1969
Total Federal Cost:	$327,629	Completion Date:	April 6, 1972

FINAL REPORT:

TITLE: NEUTRADESULFATING TREATMENT PROCESS FOR ACID MINE DRAINAGE (14010 DYH 12/71)

Author

Abstract

A process for the treatment and removal of the major pollutants has been developed. Iron and aluminum are removed by precipitation upon addition of controlled quantities of a neutralizer, such as sodium bicarbonate. Subsequently, a cyclic process is employed in which barium is eluted from a cation exchange resin, and reacts with the sulfate in the water to form a precipitate. Barium is continuously recovered and converted to a form which can be used to reload the partially exhausted resin. Sodium bicarbonate is also produced for use in the neutralization reaction. The only pollutant from the process, hydrogen sulfide, is converted to sulfur and is sold as a by-product. Treatment sections are included to insure complete recovery of barium from all outgoing streams. The process minimizes the cost of sludge and waste disposal while offering a product water which meets the highest interstate water quality standards. The treatment cost for a 1MM GPD Plant is $2.69 per thousand gallons of treated water. The project was terminated at the end of Phase I due to the high estimated cost of treatment. Copies available from the Government Printing Office, Washington, D.C. 20402, at $1.00 each.

INFORMATION SHEET

This sheet describes briefly a

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

Completed under the provisions of the

Federal Water Pollution Control Act, As Amended.

PROJECT NUMBER: 14010 DYI (14-12-529)

TITLE OF PROJECT: "Treatment of Acid Mine Drainage - Sulfur and Iron Recovery"

GRANTEE OR CONTRACTOR:	PROJECT DIRECTOR:
Black, Sivalls & Bryson, Inc. 7500 East Twelfth Kansas City, MI 64126	J. A. Karnavas 538 Alpha Drive Pittsburgh, PA 15238

SPECIFIC DATA ABOUT THE PROJECT

Total Project Cost:	$233,702	Obligation Date:	April 18, 1969
Total Federal Cost:	$233,702	Completion Date	October 17, 1970

FINAL REPORT:

TITLE: "EVALUATION OF A NEW ACID MINE DRAINAGE TREATMENT PROCESS"
(14010 DYI 02/71)

Author

Abstract

An economic and engineering evaluation of a submerged coal refuse combustion process to convert acid mine water (AMW) to potable water has been made. In this process coal refuse is burned in molten iron to supply energy and the coal refuse sulfur is trapped in a slag for eventual recovery of sulfur. Laboratory experimentation was conducted on those areas which could profoundly affect the process. Laboratory results indicated that sulfur is obtained, high slag sulfur partition ratios are achieved, fluid slags are produced, and that desulfurized slags are not suitable for AMW neutralization.

Engineering studies show that the process has potential for supplying inexpensive energy and permits the recovery of sulfur so that distilled water may be economically produced. Depending upon the AMW composition and sulfur selling price ($20 to $30/ton) the break-even price of water for a 5 MM GPD plant varies between $.42 and $.16/1,000 gals when a 14 percent capital interest charge is used.

Copies available from the Government Printing Office, Washington, D. C. 20402, at $1.50 each.

INFORMATION SHEET

This sheet describes briefly a

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

Completed under the provisions of the

Federal Water Pollution Control Act, As Amended.

PROJECT NUMBER: 14010 DYK

TITLE OF PROJECT: "Abatement of Acid Mine Drainage Pollution by Reverse Osmosis"

GRANTEE OR CONTRACTOR:

Commonwealth of Pennsylvania
Dept. of Mines & Mineral Ind.
660 Boas Street
Harrisburg, Pennsylvania
Rex-Chainbelt, Inc.

PROJECT DIRECTOR:

Dr. David R. Maneval
Director of Research and Development

SPECIFIC DATA ABOUT THE PROJECT

Total Project Cost:	$39,426	**Obligation Date:**	February 13, 1969
Total Federal Cost:	$27,598	**Completion Date:**	December 31, 1969

FINAL REPORT:

TITLE: TREATMENT OF ACID MINE DRAINAGE BY REVERSE OSMOSIS
(14010 DYK 03/70)

Author

Abstract

The unit was operated for a period of 35 days on acid mine drainage as received from the Mocanaqua discharge near Shickshinny. Operation during this period was continuous, i.e., 24 hours per day. Daily samples of feed water, product water, and waste concentrate were analyzed to determine the effectiveness of the demonstration unit.

The results obtained during the demonstration period indicated that the reverse osmosis process has potential application in acid mine drainage treatment. A high quality water was produced which was suitable for use by industries or municipalities with a minimum of additional treatment. Copies available from the Government Printing Office, Washington, D.C. 20402, at $.55 each.

INFORMATION SHEET

This sheet describes briefly a

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

Completed under the provisions of the

Federal Water Pollution Control Act, As Amended.

PROJECT NUMBER: 14010 DZM

TITLE OF PROJECT: "A Demonstration of a New Mining Technique to Prevent the Formation of Mine Acid in an Active Deep Mine"

GRANTEE OR CONTRACTOR:	PROJECT DIRECTOR:
Island Creek Coal Company Island Creek Division Holden, West Virginia	R.C. Taliaferro

SPECIFIC DATA ABOUT THE PROJECT

Total Project Cost:	$100,255	Obligation Date:	August 1, 1969
Total Federal Cost:	$70,178	Completion Date:	May 31, 1970

FINAL REPORT:

TITLE: "FEASIBILITY STUDY OF MINING COAL IN AN OXYGEN FREE ATMOSPHERE" (14010 DZM 08/70)

Author

Abstract

It was shown that it is feasible from an engineering standpoint to mine coal in an oxygen free atmosphere. Life support and associated equipment are available essentially off-the-shelf. A deep mine using conventional mining equipment can be designed to operate in an oxygen free atmosphere, such as methane. The comparative economics are extremely favorable when the methane gas is recovered and sold. This report covers Phase I of a two phase project. Phase II is discussed in the section on current projects.

Copies of this report are available from the Government Printing Office, Washington, D.C. 20402, at $1.50 each.

INFORMATION SHEET

This sheet describes briefly a

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

Completed under the provisions of the

Federal Water Pollution Control Act, As Amended.

PROJECT NUMBER: 14010 ECC (14-12-877)

TITLE OF PROJECT: "Continuation of the Laboratory Investigations of the Effects of Various Gas Atmospheres on the Oxidation of Coal Mine Pyrites"

GRANTEE OR CONTRACTOR:	PROJECT DIRECTOR:
Cyrus Wm. Rice Division NUS Corporation 1910 Cochran Road Pittsburgh, Pennsylvania 15220	Mr. J. C. Troy Vice President

SPECIFIC DATA ABOUT THE PROJECT

Total Project Cost:	$53,601.00	Obligation Date:	June 2, 1970
Total Federal Cost:	$53,601.00	Completion Date:	January 2, 1971

FINAL REPORT:

TITLE: "THE EFFECTS OF VARIOUS GAS ATMOSPHERES ON THE OXIDATION OF COAL MINE PYRITES"
(14010 ECC 08/71)

Author

Abstract

A number of experiments up to 150 days in length were conducted to study the acid production rate of coal mine pyrites under various gas atmospheres. The gas atmospheres studied were air, nitrogen, methane, and carbon dioxide. The lower limits of the oxidation process were studied by introducing small amounts of oxygen along with the inert blanketing gas and by studying the effects of deaerated versus air saturated feedwater. Acid production was found to be proportional to the available oxygen partial pressure.

The acid parameters monitored continued to change and had not completely reached a steady state by the termination of the work. The acid production of nitrogen blanketed pyrite decreased to less than 1% of that of idential columns under an air atmosphere. Nitrogen and methane gases were equally effective in reducing acid production. Both of these gases were slightly more effective than carbon dioxide. A large amount of detailed experimental data is presented.

Copies available from the Government Printing Office, Washington, D.C. 20402, at $1.25 each.

EPA Hq Form 5330-3 (6-72)

INFORMATION SHEET

This sheet describes briefly a

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

Completed under the provisions of the

Federal Water Pollution Control Act, As Amended.

PROJECT NUMBER: 14010 EFK

TITLE OF PROJECT: "Use of Latex as a Soil Sealant to Control Acid Mine Waste Drainage"

GRANTEE OR CONTRACTOR:	PROJECT DIRECTOR:
Commonwealth of Pennsylvania Dept. of Mines & Mineral Ind. 660 Boas Street Harrisburg, Pennsylvania 17102	Mr. Donald E. Fowler

SPECIFIC DATA ABOUT THE PROJECT

Total Project Cost:	$259,770.00	Obligation Date:	June 26, 1968
Total Federal Cost:	$181,839.00	Completion Date:	July 9, 1971

FINAL REPORT:

TITLE: USE OF LATEX AS A SOIL SEALANT TO CONTROL ACID MINE WASTE DRAINAGE
(14010 EFK 06/72)

Author

Abstract

A study was made to test the feasibility of using latex as a soil sealant to prevent water seepage into subterranean abandoned mines.

Soil characteristics and field conditions are defined and the results of sealing tests performed on soil columns in the laboratory are described. Many synthetic latexes, clays and other inorganic compounds give surface seals only, indicating chemical reaction with the soil or physical blockage of soil pores at the surface. Several latex compounds that penetrated the soil in laboratory columns and acted as effective sealants were tested in the field on 5' x 5' plots for permeability reduction.

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A styrene-butadiene rubber latex was applied by sprinkler irrigation on three one-quarter-acre plots, at a concentration of 4650 lbs./acre. Subsequent soil moisture and water permeability tests were conducted. Latex distribution in the soil was determined by analytical methods.

In a further study, a similar latex was sprinkled on a soil box containing a uniform sandy loam soil in a effort to understand better the mechanism of sealing action and how latex penetrates into the soil.

Copies available from the Government Printing Office, Washington, D.C., 20402, at $1.00 each.

INFORMATION SHEET

This sheet describes briefly a

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

Completed under the provisions of the

Federal Water Pollution Control Act, As Amended.

PROJECT NUMBER: 14010 EGJ

TITLE OF PROJECT: "Application of Bacteriophages to Eliminate Mine Acids"

GRANTEE OR CONTRACTOR:	PROJECT DIRECTOR:
Commonwealth of Pennsylvania Dept. of Mines & Mineral Ind. 660 Boas Street Harrisburg, Pennsylvania 17102 MSA Research Corp.	Dr. David D. Maneval Director of Research and Development

SPECIFIC DATA ABOUT THE PROJECT

Total Project Cost: $123,723	Obligation Date: June 6, 1968
Total Federal Cost: $86,484	Completion Date: September 1969

FINAL REPORT:

TITLE: "EFFECT OF ANTIBACTERIAL AGENTS ON MINE DRAINAGE"
(14010 EGJ 11/69)

Author

Abstract

A laboratory study was conducted to determine the nature of the active agents in certain natural waters that had been previously found to inhibit bacterial production of acid from mine waters. An actual coal mine situation where acid was being produced, was used to determine the feasibility of the application of the inhibitory principle.

Results of the study were inconclusive. No evidence is prevented to adequately determine the effects of antibacterial agents on acid mine drainage.

Copies available from the National Technical Information Services, Springfield, Virginia 22151, at $6.00 for #PB 191 215

EPA Hq Form 5330-3 (6-72)

INFORMATION SHEET

This sheet describes briefly a

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

Completed under the provisions of the

Federal Water Pollution Control Act, As Amended.

PROJECT NUMBER: 14010 EHN

TITLE OF PROJECT: "Detection & Location of Concealed Abandoned Underground Mines & Associated Drainage by Geochemical Techniques"

GRANTEE OR CONTRACTOR:	PROJECT DIRECTOR:
Commonwealth of Pennsylvania Dept. of Mines & Mineral Ind. 660 Boas Street Harrisburg, Pennsylvania 17102 H.R.B. Singer, Inc.	Dr. David Maneval Director of Research and Development

SPECIFIC DATA ABOUT THE PROJECT

Total Project Cost:	$164,780.00	Obligation Date:	June 20, 1969
Total Federal Cost:	$115,346.00	Completion Date:	December 31, 1970

FINAL REPORT:

TITLE: DETECTION OF ABANDONED UNDERGROUND COAL MINES BY GEOPHYSICAL METHODS (14010 EHN 4/71)

Author

Abstract

Drilling is the only known method for accurately determining the location and extent of the mine voids, but this is extremely expensive. This project attacks the problem through field studies of the following geophysical methods: electrical resistivity, self-potential, infrared radiometry, total field and differential magnetometry, seismic refraction and reflection, very low frequency electromagnetic and induced polarization over well documented, drift, coal mines. Airborne infrared radiometry proved to be an excellent tool for detecting and mapping acid mine/fresh water sources, acid mine/fresh water drainage, and fracture traces under selected conditions. Resistivity and magnetics anomalies coincide with some (not all) drift mine entries. Induced polarization data shows some apparent correlations with mine workings. Other methods tested did not yield correlatable information. Conventional geophysical approaches to this problem do not appear adequate for the task. Unconventional approaches including high frequency seismic, shear wave seismic, and induced polarization methods may provide answers pending their further development.

INFORMATION SHEET

This sheet describes briefly a

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

Completed under the provisions of the

Federal Water Pollution Control Act, As Amended.

PROJECT NUMBER: 14010 EIZ

TITLE OF PROJECT: "Optimization and Development of Improved Chemical Techniques for the Treatment of Coal Mine Drainage"

GRANTEE OR CONTRACTOR:	PROJECT DIRECTOR:
Commonwealth of Pennsylvania Dept. of Mine & Mineral Ind. 660 Boas Street Harrisburg, Pa. 17102 Bituminous Coal Research, Inc.	Dr. David D. Maneval Director of Research and Development

SPECIFIC DATA ABOUT THE PROJECT

Total Project Cost: $150,000	Obligation Date: February 7, 1968
Total Federal Cost: $105,000	Completion Date: January 1970

FINAL REPORT:

TITLE: "STUDIES ON LIMESTONE TREATMENT OF ACID MINE DRAINAGE"
(14010 EIZ 01/70)

Author

Abstract

Four coal mine waters have been neutralized with limestone both on a batch scale and by utilizing continuous flow apparatus. Variations in treatment procedure were necessary depending on the characteristics of the individual waters.

A standardized test was established to evaluate the reactivity of the limestones. The following variables are of importance in evaluating limestones for coal mine water neutralization: (a) particle size, (b) Ca and Mg content, and (c) surface area.

Electrophoretic mobility studies on precipitates obtained by both lime and limestone neutralization of coal mine water yielded information which can be applied for more effective sludge removal.

Copies available from the Government Printing Office, Washington, D. C. 20402, at $1.25 each.

INFORMATION SHEET

This sheet describes briefly a

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

Completed under the provisions of the

Federal Water Pollution Control Act, As Amended.

PROJECT NUMBER: 14010 EIZ

TITLE OF PROJECT: "Development and Optimization of the Limestone Treatment of Coal Mine Drainage"

GRANTEE OR CONTRACTOR:	PROJECT DIRECTOR:
Commonwealth of Pennsylvania Dept. of Mines & Mineral Ind. 660 Boas Street Harrisburg, Pennsylvania 17102 Bituminous Coal Research, Inc.	Mr. John J. Buscavage

SPECIFIC DATA ABOUT THE PROJECT

Total Project Cost:	$106,480.00	Obligation Date:	June 25, 1969
Total Federal Cost:	$74,536.00	Completion Date:	June 25, 1971

FINAL REPORT:

TITLE: STUDIES ON LIMESTONE TREATMENT OF ACID MINE DRAINAGE - PART II (14010 EIZ 12/71)

Author

Abstract

Laboratory studies were conducted with limestone as the neutralizing agent for coal mine water. Batch tests were used to determine the properties of limestone necessary for effective neutralization. Continuous flow tests were used to determine conditions required for an effective neutralization process.

The following variables are of importance for limestone to be an effective neutralizing agent: (a) particle size, (b) Ca and Mg content, and (c) surface area. Limestones having the smallest particle size commercially available were tested and found to be effective if criteria for variables other than particle size were met.

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Data obtained with a small laboratory continuous flow test apparatus were used in determining operating conditions for a continuous treatment process for neutralizing mine water with limestone. An evaluation of this process indicated technical feasibility, advantages and disadvantages, and need for further study of certain aspects of this process.

The cost of treating coal mine water with the BCR limestone treatment process compares favorably with the published costs of treating mine water by other processes.

Copies available from the Government Printing Office, Washington, D.C. 20402, at $1.25 each.

INFORMATION SHEET

This sheet describes briefly a

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

Completed under the provisions of the

Federal Water Pollution Control Act, As Amended.

PROJECT NUMBER: 14010 EJE

TITLE OF PROJECT: "Mine Spoil Potentials for Water Quality and Controlled Erosion"

GRANTEE OR CONTRACTOR:	PROJECT DIRECTOR:
West Virginia Board of Governors West Virginia University Morgantown, West Virginia 26506	Dr. Richard M. Smith Department of Agronomy & Genetics

SPECIFIC DATA ABOUT THE PROJECT

Total Project Cost:	$224,028.00	Obligation Date:	June 30, 1969
Total Federal Cost:	$156,328.00	Completion Date:	June 30, 1971

FINAL REPORT:

TITLE: "MINE SPOIL POTENTIALS FOR WATER QUALITY AND CONTROLLED EROSION" (14010 EJE 12/71)

Author

Abstract

Extensive geologic and soils information and classification provide the basis for applying adapted chemical, physical, and mineralogical measurements to selected rock and soil profiles involved in surface mining, and for expanding results to other points or regions for prevention of acid, sediment, and other pollution.

With Mahoning sandstone, the common weathering depth of 6 meters contains essentially no disseminated pyrite. The originally gray quartzose pyritic sandstone weathers brown, and plant nutrients Ca, Mg, and K are removed by acid leaching. Moderate liming and fertilization of the brown rock and soil enable ground covers to protect spoil surfaces and assure quality waters.

Weathering in spoils, and laboratory simulations, both with and without appropriate chemoautotrophic organisms, reflect rock textures, mineral species, and pyrite oxidation with release of acid. Resulting net acidity or basicity influences soil and water quality.

Old barren spoils confirm that pH is the prime variable associated with lack of vegetation but available water is limiting on sandy, stony spoils.

Fissile iron ore spoils 70 to 130 years old showed that rooting depths and available water capacities were superior to original soils. Site quality for trees or pasture, and water quality were not significantly different between spoils and natural soils.

Copies available from the Government Printing Office, Washington, D.C. 20402, at $1.75 each.

INFORMATION SHEET

This sheet describes briefly a

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

Completed under the provisions of the

Federal Water Pollution Control Act, As Amended.

PROJECT NUMBER: 14010 EJT

TITLE OF PROJECT: "Recovery of Iron in a More Dense Form from Coal Mine Drainage"

GRANTEE OR CONTRACTOR:
Commonwealth of Pennsylvania
Dept. of Mines & Mineral Ind.
660 Boas Street
Harrisburg, Pennsylvania 17102
Bituminous Coal Research, Inc.

PROJECT DIRECTOR:
Mr. John J. Buscavage

SPECIFIC DATA ABOUT THE PROJECT

Total Project Cost: $81,695.00

Obligation Date: September 26, 1969

Total Federal Cost: $57,186.00

Completion Date: May 24, 1971

FINAL REPORT:

TITLE: STUDIES ON DENSIFICATION OF COAL MINE DRAINAGE SLUDGE (14010 EJT 9/71)

Author

Abstract

In the first approach, conditions commonly employed in the lime treatment procedure (lime neutralization and aeration) were altered to produce a dense, fast-settling, ferromagnetic sludge. Although the properties of this sludge are sufficiently unique, the magnetic sludge conversion process includes a requirement for sludge heating and is quite sensitive to the presence of small amounts of aluminum in the original mine water.

In the second approach, recognized conditioning methods were applied to sludges obtained by the usual treatment procedure involving lime neutralization and aeration. These methods included the use of coagulant aids, sludge bulk additives (filter aids), seeding materials, and sludge heating and freezing.

In addition, exploratory tests were conducted on the introduction of carbon dioxide into the mine water to promote coprecipitation of calcium carbonate during lime addition.

Copies available from the Government Printing Office, Washington, D.C. 20402, at $1.25 each.

INFORMATION SHEET

This sheet describes briefly a

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

Completed under the provisions of the

Federal Water Pollution Control Act, As Amended.

PROJECT NUMBER: 14010 EMS

TITLE OF PROJECT: "Technical Feasibility and Analysis of Costs and Effectiveness of Bulk Transport of Sewage Treatment Plant Sludge and Dredging Spoils"

GRANTEE OR CONTRACTOR:
Bechtel Corporation
50 Beale Street
San Francisco, California 94105

PROJECT DIRECTOR:
E.J. Wasp
Project Manager

SPECIFIC DATA ABOUT THE PROJECT

Total Project Cost: $279,597.00

Obligation Date: April 10, 1968

Total Federal Cost: $279,597.00

Completion Date: December 1969

FINAL REPORT:

TITLE: BULK TRANSPORT OF WASTE SLURRIES TO INLAND & OCEAN DISPOSAL SITES (14010 EMS 9/69) Vols. I-III
Summary (14010 EMS 12/69)

Author

Abstract

This four volume study is concerned with the development of regional land and ocean pipeline disposal systems for digested sewage sludge and maintenance dredgings. Volume I considers a land disposal system of Northeast Ohio (Cleveland-Canton) and an ocean disposal system for the Baltimore-Washington region. A systems approach is used, in which collection, transportation, and disposal aspects are examined. Various transport modes are compared, including pipeline, ocean tankers, railroads, and trucks. The study also considers the expansion of such systems to include fly ash and water treatment plant sludge.

Volume II discusses methods and cost of disposal for all four wastes. Land and ocean disposal alternatives in terms of a general solution is presented for two metropolitan regions, Great Lakes, Buffalo to Milwaukee, and Atlantic Coast, Boston to Norfolk.

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Results of a test program for pumping digested sludge, fly ash, and sludge-fly ash slurries are included in Volume III as well as rheological tests. A review of the state of the art of pipelining of waste materials is also included.

A summary of the above three volumes is presented. Copies available from the National Technical Information Services, Springfield, Virginia 22151 Volume I (189 757) Volume II (189 758) Volume III (189 759) Summary (189 756) $3.00 each.

INFORMATION SHEET

This sheet describes briefly a

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

Completed under the provisions of the

Federal Water Pollution Control Act, As Amended.

PROJECT NUMBER: 14010 ENW

TITLE OF PROJECT: "Microbiological Removal of Iron from Mine Drainage Waters"

GRANTEE OR CONTRACTOR:	PROJECT DIRECTOR:
Continental Oil Company P. O. Drawer 1267 Ponca City, Oklahoma	Ray C. Allred Supervising Research Scientist

SPECIFIC DATA ABOUT THE PROJECT

Total Project Cost: $115,996	Obligation Date: September 1, 1967
Total Federal Cost: $75,886	Completion Date: March 31, 1971

FINAL REPORT:

TITLE: "MICROBIOLOGICAL TREATMENT OF ACID MINE DRAINAGE WATERS" (14010 ENW 09/71)

Author

Abstract

Laboratory studies demonstrated that both pure cultures and fresh field cultures of acidophilic iron bacteria could readily oxidize ferrous iron in both synthetic and natural acid mine drainage waters. In the presence of adequate forms and amounts of oxygen, carbon dioxide, nitrogen and phosphorus, ferrous iron was oxidized at rates up to 600 mg/l/hr. Average oxidation rate was found to vary with the ferrous iron concentration in the water: i.e., the higher the ferrous iron content, the greater the oxidation rate. Approximate requirements of oxygen, carbon dioxide, nitrogen and phosphorus by the iron bacteria were established.

Multistaging of oxidation vessels in series was found to produce a more effective microbial oxidation system than use of a single oxidation reservior.

Limestone neutralizations of partially oxidized acid mine waters showed that such waters containing up to 90 mg/l ferrous iron could be successfully neutralized and result in discharge waters containing $\leq$7 mg/l total iron.

INFORMATION SHEET

This sheet describes briefly a

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

Completed under the provisions of the

Federal Water Pollution Control Act, As Amended.

PROJECT NUMBER: 14010 ETV

TITLE OF PROJECT: "Neutralization of High Ferric Iron Acid Mine Drainage"

GRANTEE OR CONTRACTOR:	PROJECT DIRECTOR:
Robert A. Taft Water Research Center Federal Water Quality Administration Cincinnati, Ohio 45226	Roger C. Wilmoth

SPECIFIC DATA ABOUT THE PROJECT

Total Project Cost:

Obligation Date:

Total Federal Cost:

Completion Date:

FINAL REPORT:

TITLE: NEUTRALIZATION OF HIGH FERRIC IRON ACID MINE DRAINAGE
(14010 ETV-08/70)

Author

Abstract

Lime, limestone and soda ash were studied as neutralizing agents for treatment of a ferric iron acid mine drainage water. Both continuous flow and batch tests were used to determine their effectiveness. Comparisons made between the three include: chemical costs, reaction efficiencies, effluent water qualities, sludge settling rates, sludge volumes, and percent solids of sludges.

All three were capable of treating acid mine drainage. Lime costs were half that of limestone for treating the same acid mine drainage because of the low utilization of limestone. However, the characteristics of the limestone sludge were superior to those of lime and soda ash sludges. The cost for soda ash treatment was excessive.

Copies available from the Government Printing Office, Washington, D.C, 20402, at $.50 each.

EPA Hq Form 5330-3 (6-72)

INFORMATION SHEET

This sheet describes briefly a

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

Completed under the provisions of the

Federal Water Pollution Control Act, As Amended.

PROJECT NUMBER: 14010 EXA (14-12-97)

TITLE OF PROJECT: "A Pilot-Scale Study of Acid Mine Drainage"

GRANTEE OR CONTRACTOR:	PROJECT DIRECTOR:
Ohio State University Research Foundation 1314 Kinnear Road Columbus, Ohio 43212	Dr. E.E. Smith Associate Professor of Civil Engineering

SPECIFIC DATA ABOUT THE PROJECT

Total Project Cost:	$79,301.00	**Obligation Date:**	June 30, 1967
Total Federal Cost:	$79,301.00	**Completion Date:**	September 30, 1971

FINAL REPORT:

TITLE: PILOT PLANT STUDY OF ACID MINE DRAINAGE
(14010 EXA 3/71)

Author

Abstract

A research facility has been developed to study pyrite oxidation and the resulting acid mine drainage on a pilot scale basis. The test units include a small, long-abandoned drift mine (the McDaniels Mine), and six 33-inch diameter auger holes, drilled for the express purpose of furnishing comparable, isolated, experimental units.

The effect of oxygen concentration on acid production has been studied in the McDaniels mine. The response time of the mine to imposed mine atmospheres of varying oxygen concentrations, mine drainage data, and information derived from bore holes through the overburden around the mine, provide the basis for describing sites of pyrite oxidation and the significance of bacterial catalysis on oxidation rate. Results to date indicate that the major reaction sites are located above the ground water table where gas, rather than liquid, is the continuous phase. There is no indication of significant bacterial catalysis of pyrite oxidation.

The six auger holes were drilled in order to provide duplicate experimental units. By using one or more of the holes as a reference mine, the fluctuations due to hydrologic variations can be separated from changes brought about by an imposed change in environmental conditions, and a more accurate evaluation of the effect of the environment on mine drainage can be made. The units also provide experimental flexibility and enhance the progress of the experimental program which is restricted to one experiment per year per unit by annual ground water fluctuations and by the slow response time of underground pyritic systems to imposed environmental changes.

Copies available from the Government Printing Office, Washington, D.C. 20402, at $1.00 each.

INFORMATION SHEET

This sheet describes briefly a

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

Completed under the provisions of the

Federal Water Pollution Control Act, As Amended.

PROJECT NUMBER: 14010 FBZ (14-12-847)

TITLE OF PROJECT: "The Effect of Soluble Iron Upon Municipal Waste Treatment Facilities"

GRANTEE OR CONTRACTOR:	PROJECT DIRECTOR:
Resources Engineering Assoc. Environmental Research & Application, Inc. Wilton, Connecticut 06897	Richard J. Benoit, Ph.D.

SPECIFIC DATA ABOUT THE PROJECT

Total Project Cost:	$21,745.00	Obligation Date:	June 24, 1970
Total Federal Cost:	$21,745.00	Completion Date:	December 24, 1970

FINAL REPORT:

TITLE: "CONCENTRATED MINE DRAINAGE DISPOSAL INTO SEWAGE TREATMENT SYSTEMS" (14010 FBZ 9/71)

Author

Abstract

The effect of artifical iron-rich acid brines on municipal sewage treatment processes was studied in small scale. The brines were devised to simulate concentrates from treatment of acid mine drainage. The processes included primary settling, activated sludge digestion, and other unit processes.

The raw brines even at a level of 20% vol/vol or higher do not interfere with primary settling, but activated sludge digestion is completely inhibited by the acid. The brines when neutralized with lime improve primary settling and the neutralized brines do not inhibit activated sludge. Filtration of all sewage fractions is improved by the lime-acid brine neutral mixture. At the very high concentrations used, the neutralized brines give virtually complete removal of phosphate from primary effluent, activated sludge effluent, or anaerobic sludge digester decantate. Engineering analysis and costs are shown for transporting the brine from the mine site to the sewage treatment plant.

Copies available from the Government Printing Office, Washington, D.C. 20402, at $.75 each.

INFORMATION SHEET

This sheet describes briefly a

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

Completed under the provisions of the

Federal Water Pollution Control Act, As Amended.

PROJECT NUMBER: 14010 FII

TITLE OF PROJECT: "Evaluation of Pyritic Oxidation by Nuclear Methods"

GRANTEE OR CONTRACTOR:	PROJECT DIRECTOR:
Carnegie-Mellon University 4400 Fifth Avenue Pittsburgh, Pennsylvania 15213	Robert A. Baker Senior Fellow Mellon Institute Carnegie-Mellon University

SPECIFIC DATA ABOUT THE PROJECT

Total Project Cost:	$39,635.00	Obligation Date:	March 4, 1970
Total Federal Cost:	$35,672.00	Completion Date:	November 30, 1970

FINAL REPORT:

TITLE: "EVALUATION OF PYRITIC OXIDATION BY NUCLEAR METHODS" (14010 FII 3/71)

Author

Abstract

Laboratory studies demonstrated the feasibility of using the Mössbauer effect and a backscattering mode of detecting 14.4 Kev gamma rays to spectroscopically monitor the oxidation processes taking place on pyrite materials. A cobaltous oxide form of cobalt-57 was the radiation source.

Spectra were obtained of pyritic surfaces under 2mm of water. Differentiation of nonoxidized and oxidized pyritic surfaces was possible with further separation of the spectra to show individual oxidation product peaks suggesting ferric hydroxide and ferric sulfate.

Copies available from the Government Printing Office, Washington, D.C. 20402, at $.50 each.

INFORMATION SHEET

This sheet describes briefly a

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

Completed under the provisions of the

Federal Water Pollution Control Act, As Amended.

PROJECT NUMBER: 14010 FJX

TITLE OF PROJECT: "The Thickening and Dewatering of Precipitates from the Lime/Limestone Treatment of Mine Drainage"

GRANTEE OR CONTRACTOR:
West Virginia Board of Regents
West Virginia University
Morgantown, W.VA. 26506

PROJECT DIRECTOR:
Joseph W. Leonard, Director
Coal Research Bureau School
of Mines

SPECIFIC DATA ABOUT THE PROJECT

Total Project Cost: $99,938.40

Obligation Date: February 5, 1970

Total Federal Cost: $69,956.88

Completion Date: July 1, 1972

FINAL REPORT:

TITLE: "DEWATERING OF MINE DRAINAGE SLUDGE" (14010 FJX 12/71)

Author

Abstract

The effects of mine water constituents and methods of treatment on the physical and chemical characteristics of the resulting sludge are described. Such current practices as aeration, recirculation and neutralization are discussed. Additional techniques at various stages of development, such as thickening, conditioning, and dewatering are evaluated for use in coal mine drainage treatment.

The most promising coal mine sludge dewatering technique appears to be vacuum filtration. Other methods such as sand bed filtration, pressure filtration and centrifugation may also be applicable.

Recommendations are made as to the areas in coal mine drainage treatment and sludge densification that need further research.

The continuation of this project is described in the section on on-going projects.

Copies available from the Government Printing Office, Washington, D. C. 20402, at $1.00 each.

INFORMATION SHEET

This sheet describes briefly a

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

Completed under the provisions of the

Federal Water Pollution Control Act, As Amended.

PROJECT NUMBER: 14010 FKK

TITLE OF PROJECT: "Mining Operations for the Reduction of Harmful Drainage from Underground Coal Mines"

GRANTEE OR CONTRACTOR:
West Virginia Board of
Regents
West Virginia University
Morgantown, West Virginia 26506

PROJECT DIRECTOR:
Joseph W. Leonard, Director
Coal Research Bureau
School of Mines

SPECIFIC DATA ABOUT THE PROJECT

Total Project Cost: $87,543.40

Obligation Date: March 4, 1970

Total Federal Cost: $83,166.23

Completion Date: October 2, 1971

FINAL REPORT:

TITLE: UNDERGROUND MINING METHODS TO ABATE WATER POLLUTION (14010 FKK 12/70)

Author

Abstract

This report includes published information about the abatement of harmful drainage from underground coal mines. Although much has been written on mine water management, very little literature is available on the specific area of mining to prevent the formation of acid water. The references included in this report, which involve mining engineering and mining oriented hydrology studies, span that period of time when water quantity rather than quality was the major consideration. Both physical and chemical approaches to the problem of preventing water entry into coal mines, and/or preventing the formation of acid mine water, are included.

INFORMATION SHEET

This sheet describes briefly a

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

Completed under the provisions of the

Federal Water Pollution Control Act, As Amended.

PROJECT NUMBER:14010 FLW (14-12-848)

TITLE OF PROJECT:"Feasibility Manual for Mine Drainage"

GRANTEE OR CONTRACTOR:
C. W. Rice Division
NUS Corporation
Manor Oak Two
1910 Cochran Road
Pittsburgh, PA 15220

PROJECT DIRECTOR:
Mr. James K. Rice

SPECIFIC DATA ABOUT THE PROJECT

Total Project Cost: $40,909

Obligation Date: March 4, 1970

Total Federal Cost: $40,909

Completion Date:July 1970

FINAL REPORT:

TITLE: "FEASIBILITY STUDY MANUAL - MINE WATER POLLUTION CONTROL DEMONSTRATIONS" (14010 FLW 07/70)

Author

Abstract

This manual is to be used as a guide by State or interstate agencies in uniformly performing feasibility studies for projects proposed to demonstrate methods for the abatement of mine drainage pollution as required by Section 14 of the Federal Water Pollution Control Act as amended.

The required feasibility studies are to aid the Administrator of Environmental Protection Agency in selecting the mine drainage pollution control method or methods suitable for demonstration, and also the optimum watershed where the effectiveness of the project will have the greatest public value or uses.

INFORMATION SHEET

This sheet describes briefly a

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

Completed under the provisions of the

Federal Water Pollution Control Act, As Amended.

PROJECT NUMBER: 14010 FMH (14-12-838)

TITLE OF PROJECT: "Treatment of Acid Mine Drainage by Ozone Oxidation"

GRANTEE OR CONTRACTOR:	PROJECT DIRECTOR:
U.S. Atomic Energy Commission Upton, Long Island New York 11973	E.L. Van Horn, Manager Brookhaven National Laboratory

SPECIFIC DATA ABOUT THE PROJECT

Total Project Cost:	$20,000.00	Obligation Date:	March 13, 1970
Total Federal Cost:	$20,000.00	Completion Date:	September 12, 1970

FINAL REPORT:

TITLE: TREATMENT OF MINE DRAINAGE BY OZONE OXIDATION (14010 FMH 12/70)

Author

Abstract

An engineering design and economic study to evaluate the feasibility of ozone oxidation and limestone neutralization of Acid Mine Drainage (AMD) was performed. The study concludes that an ozone process is feasible, compares economically with existing processes, and offers potential advantages in process control, reduced neutralization costs, and simplified AMD sludge handling and disposal. Ozone production by electric discharge and radiation processes are compared both for on-site and central plant installations utilizing ozone shipping and storage facilities. A central chemonuclear ozone production plant with a distribution system is found to be most economical, followed by electric discharge central and on-site plants. Design and construction of a mobile pilot plant which employs electric discharge ozonizers is recommended for field trials of the process.

Copies available from the Government Printing Office, Washington, D.C. 20402, at $1.00 each.

EPA Hq Form 5330-3 (4-72)

INFORMATION SHEET

This sheet describes briefly a

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

Completed under the provisions of the

Federal Water Pollution Control Act, As Amended.

PROJECT NUMBER: 14010 FNQ (14-12-859)

TITLE OF PROJECT: "Electrochemical Treatment of Acid Mine Waters"

GRANTEE OR CONTRACTOR:	PROJECT DIRECTOR:
Tyco Laboratories, Inc. Corporate Research Division Bear Hill Waltham, Massachusetts 02154	Dr. Bertram Keilin, Head Environmental Sciences Dept.

SPECIFIC DATA ABOUT THE PROJECT

Total Project Cost:	$81,160.00	**Obligation Date:**	April 21, 1970
Total Federal Cost:	$81,160.00	**Completion Date:**	April 20. 1971

FINAL REPORT:

TITLE: ELECTROCHEMICAL TREATMENT OF ACID MINE WATERS
(14010 FNQ 2/72)

Author

Abstract

Experimental and analytical evaluations of the direct electrochemical oxidation of ferrous acid mine drainage (AMD) have shown that this approach is economically superior to present lime treatment and aeration methods. Througn the use of a packed bed electrode, the size of the oxidation reactor has been reduced to a stage where the capital investment required for this equipment can be recovered by cost reductions in latter treatment stages.

As a bonus, electrolytic hydrogen, produced during electrochemical oxidation, should be economically recoverable at high AMD treatment rates.

Preliminary economic estimates of total treatment costs indicate a cost range from 11¢ to 72¢/1000 gal, exclusive of hydrogen credits. These costs are much less than those of present treatment approaches which appear to have expense rates of from 20¢ to $2.00/1000 gal treated. In the particular case of a badly polluted stream containing 2000 mg/l of $CaCO_3$ acidity, the total treatment cost 31¢/1000 gallon for the electrochemical oxidation approach is less than the

reagent cost alone (35¢/1000 gal) for conventional lime treatment.

Copies available from the Government Printing Office, Washington, D.C. 20402, at $1.00 each.

INFORMATION SHEET

This sheet describes briefly a

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

Completed under the provisions of the

Federal Water Pollution Control Act, As Amended.

PROJECT NUMBER: 14010 FOA

TITLE OF PROJECT: "Coal Refuse Binder"

GRANTEE OR CONTRACTOR:
Black, Sivalls, & Bryson, Inc.
538 Alpha Drive
Pittsburgh, Pennsylvania 15238

PROJECT DIRECTOR:
Mr. P.J. LaRosa

SPECIFIC DATA ABOUT THE PROJECT

Total Project Cost:	$18,894.00	Obligation Date:	March 19, 1970
Total Federal Cost:	$13,226.00	Completion Date:	August 31, 1970

FINAL REPORT:

TITLE: "CARBONATE BONDING OF COAL REFUSE"
(14010 FOA 2/71)

Author

Abstract

A laboratory study of the operating variables which affect the properties of carbonate bonded coal refuse has been made. The carbonate bonding process utilizing coal refuse as a fill material consists of mixing coal refuse with water and lime hydrate, compacting the mixture, and reacting it with a carbon dioxide-rich gas to form a coherent structure bonded by a matrix of calcite crystals. The resulting carbonate bonded coal refuse can be used in road building or as a coal refuse pile sealant to minimize acid mine water pollution.

Four types of coal refuse were investigated--a relatively unoxidized and highly oxidized bituminous coal refuse and a relatively unoxidized and highly oxidized anthracite coal refuse. It was found that compressive strengths of 2200 to 4400 psi were obtained for the four types of coal refuse investigated using up to 12 percent lime hydrate and 9 to 15 percent water.

The air and water permeability of carbonate bonded coal refuse was found to be comparable to concrete. An approximate cost comparison between carbonate bonded coal refuse and other construction materials and techniques indicated that the carbonate bonding process utilizing coal refuse is the most economical means available for coal refuse pile sealing and road building.

Copies available from the Government Printing Office, Washington, D.C. 20402, at $.60 each.

INFORMATION SHEET

This sheet describes briefly a

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

Completed under the provisions of the

Federal Water Pollution Control Act, As Amended.

PROJECT NUMBER: 14010 FPQ

TITLE OF PROJECT: "Biological Treatment of Acid Mine Water"

GRANTEE OR CONTRACTOR:	PROJECT DIRECTOR:
Syracuse University Research Institute 201 Marshall Street Syracuse, N.Y. 13210	Dr. D. A. Rice Assistant Professor of Chemical Engineering

SPECIFIC DATA ABOUT THE PROJECT

Total Project Cost: $54,341	Obligation Date: June 11, 1968
Total Federal Cost: $47,238	Completion Date: June 10, 1971

FINAL REPORT:

TITLE:

Author

Abstract

This project was intended to gather basic process data on the treatment of acid water in an anaerobic biological reactor containing the species Desulfovibrio desulfoxidans. Subsequently, a set of parametric experiments was to be carried out to determine the relationship between ionic concentrations and process conditions. Appropriate mathematical models were to be developed to describe the relationships and to indicate controlling mechanisms.

The project did not successfully accomplish its goal. A final report of this project will not be published.

INFORMATION SHEET

This sheet describes briefly a

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

Completed under the provisions of the

Federal Water Pollution Control Act, As Amended.

PROJECT NUMBER: 14010 FPR

TITLE OF PROJECT: "Acid Mine Drainage - An Analysis of the State of the Art"

GRANTEE OR CONTRACTOR:	PROJECT DIRECTOR:
The Ohio State University Research Foundation 1314 Kinnear Road Columbus, Ohio 43212	George P. Hanna, Jr. Director, Water Resources

SPECIFIC DATA ABOUT THE PROJECT

Total Project Cost:	$28,811	Obligation Date:	November 28, 1967
Total Federal Cost:	$28,811	Completion Date:	June 30, 1969

FINAL REPORT:

TITLE: "ACID MINE DRAINAGE FORMATION AND ABATEMENT"
(14010 FPR 04/71)

Author

Abstract

This report pertains to at-source control of pyrite oxidation. The current level of knowledge of acid mine drainage formation is reviewed, with emphasis on reaction kinetics and reactant and product transport. A reaction system model is developed, providing a framework for discussion dealing specifically with the physical, chemical, and biological characteristics of pyritic systems encountered in mining situations. Practical considerations of at-source control of acid mine drainage formation are presented in the final section. Deficiencies in current knowledge brought out by this report include: Descriptions of the physical environment existing at pyrite oxidation sites in natural systems are far more incomplete than current understanding of pyrite oxidation kinetics; oxygen transport is poorly described at this time, but is probably rate-controlling in most instances; the effectiveness of air-sealing techniques as currently practiced is questionable; the significance of bacterial catalysis of pyrite oxidation under field conditions has not been established.

Copies available from the National Technical Information Services, Springfield, Virginia 22151, at $3.00 for #PB 199 835.

EPA Hq Form 5330-3 (6-72)

INFORMATION SHEET

This sheet describes briefly a

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

Completed under the provisions of the

Federal Water Pollution Control Act, As Amended.

PROJECT NUMBER: 14010 FPS

TITLE OF PROJECT: "Study of Sulfide to Sulfate Reaction Mechanism"

GRANTEE OR CONTRACTOR:	PROJECT DIRECTOR:
The Ohio State University Research Foundation 1314 Kinnear Road Columbus, Ohio 43212	Dr. E. E. Smith Associate Professor of Chemical Engineering

SPECIFIC DATA ABOUT THE PROJECT

Total Project Cost:	$152,763	Obligation Date:	May 20, 1968
Total Federal Cost:	$151,402	Completion Date:	February 1970

FINAL REPORT:

TITLE: "SULFIDE TO SULFATE REACTION MECHANISM" (14010 FPS 02/70)

Author

Abstract

The mechanisms and kinetics of the chemical reactions responsible for acid mine drainage were studied.

The mineralogical features of the solid phase reactant (pyrite) that determine its reactivity and the rate-limiting reactions and variables affecting this rate of reaction are described and identified.

It was found that two basic oxidation modes are important: oxygenation, in which oxygen is the immediate oxidizing agent: and ferric ion (or microbiologically catalyzed) oxidation, in which ferric ions are the oxidants. From a knowledge of the dissolved oxygen, ferric/ferrous ratio, and total iron ion content at the reaction site, the reaction regime may possibly be determined.

Copies available from the Government Printing Office, Washington, D. C. 20402, at $1.50 each.

INFORMATION SHEET

This sheet describes briefly a

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

Completed under the provisions of the

Federal Water Pollution Control Act, As Amended.

PROJECT NUMBER: 14010 FQR

TITLE OF PROJECT: "Abatement of Acid Mine Drainage Pollution by Reverse Osmosis"

GRANTEE OR CONTRACTOR:	PROJECT DIRECTOR:
Commonwealth of Pennsylvania Dept. of Mines & Mineral Ind. 660 Boas Street Harrisburg, PA. 17102 Rex-Chainbelt, Inc.	Donald E. Fowler

SPECIFIC DATA ABOUT THE PROJECT

Total Project Cost: $69,630	Obligation Date: June 3, 1970
Total Federal Cost: $48,741	Completion Date: November 15, 1971

FINAL REPORT:

TITLE: "REVERSE OSMOSIS DEMINERALIZATION OF ACID MINE DRAINAGE"
(14010 FQR 03/72)

Author

Abstract

The objective of this study was to determine the operational methods and procedures necessary to successfully demineralize acid mine drainage utilizing reverse osmosis (RO). The study was conducted in two phases. Phase I consisted of laboratory bench scale investigations to determine methods for controlling iron fouling and to select a process flow sheet. Phase II was the field operation based on the flow sheet selected in Phase I.

The results obtained indicated that it was feasible to demineralize acid mine drainage by reverse osmosis. Membrane fouling due to iron was satisfactorily controlled. The recovery of product water was limited to about 75% due to calcium sulfate fouling. Product water was of potable quality in all respects except for iron, manganese, and pH. Neutralization, oxidation and filtration would be required to meet potable standards.

Copies available from the Government Printing Office, Washington, D. C. 20402, at $1.00 each.

INFORMATION SHEET

This sheet describes briefly a

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

Completed under the provisions of the

Federal Water Pollution Control Act, As Amended.

PROJECT NUMBER: 14010 FUI (14-12-876)

TITLE OF PROJECT: "Treatment of Acid Mine Drainage"

GRANTEE OR CONTRACTOR:	PROJECT DIRECTOR:
Horizons Incorporated Cleveland, OH 44104	Selwyn H. Rose, Head Inorganic Chemistry Dept.

SPECIFIC DATA ABOUT THE PROJECT

Total Project Cost:	$88,008	**Obligation Date:**	June 12, 1970
Total Federal Cost:	$88,008	**Completion Date:**	June 11, 1971

FINAL REPORT:

TITLE: "FOAM SEPARATION OF ACID MINE DRAINAGE" (14010 FUI 10/71)

Author

Abstract

Laboratory studies of continuous flow foam separation were conducted to determine the optimum operating conditions for maximum extraction of dissolved metal cations (Fe, Ca, Mg, Mn, and Al) from acid mine drainage. Foaming experiments were conducted in a 6 in.-diameter glass column capable of liquid flow rates of 3-12 gal. per hour. The approach to foam separation taken was the production of persistent foams which allowed protracted foam drainage to reduce liquid carry-over in the foam. The effects of pH, chelate addition, surfactant type and concentration, air sparging rate, metal concentration and foam drainage were investigated in relation to metal extraction.

The low extraction capacity of foam fractionation renders the process economically unfeasible for the treatment of acid mine drainage. The principal chemical cost is for surfactant followed by air; either alone makes the process noncompetitive.

Copies available from the Government Printing Office, Washington, D. C. 20402, at $.65 each.

INFORMATION SHEET

This sheet describes briefly a

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

Completed under the provisions of the

Federal Water Pollution Control Act, As Amended.

PROJECT NUMBER: 14010 FYY (14-12-929)

TITLE OF PROJECT: "Study of Sulfur Recovery from Coal Mine Refuse as a Profitable Means of Eliminating Acid Water Drainage from Coal Refuse Piles"

GRANTEE OR CONTRACTOR:

Black, Sivalls & Bryson, Inc.
135 Delta Drive
Pittsburgh, PA 15238

PROJECT DIRECTOR:

Dr. Paul J. LaRosa

SPECIFIC DATA ABOUT THE PROJECT

Total Project Cost: $34,000	Obligation Date: September 15, 1970
Total Federal Cost: $34,000	Completion Date: May 15, 1971

FINAL REPORT:

TITLE: "STUDY OF SULFUR RECOVERY FROM COAL REFUSE"
(14010 FYY 09/71)

Author

Abstract

During coal preparation, a coal refuse of no commercial value is produced and discarded in piles. As rainfall percolates through the piles, acid waters are formed.

A feasibility study has been performed on a process producing sulfur from such coal refuse. In this process, limestone and coal refuse are ground, pelletized and preheated before entering a desulfurizing shaft reactor where a hard, fired ash pellet and an H_2S-SO_2 bearing offgas are produced. After sulfur, tar, and other gases are removed, the resulting H_2S-SO_2 gas proceeds to a conventional sulfur recovery plant.

Experimental results and economics of this study indicate that the process is a profitable means of minimizing coal refuse pile water pollution. For a sulfur and ash pellet selling price of $20 and $1.50/ton respectively, it is estimated that a coal producer will have a before tax return on investment up to 53 percent for one MM ton/year plant utilizing an eight percent sulfur refuse.

Copies available from the Government Printing Office, Washington, D. C. 20402, at $.70 each.

INFORMATION SHEET

This sheet describes briefly a

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

Completed under the provisions of the

Federal Water Pollution Control Act, As Amended.

PROJECT NUMBER: 14010 FZU

TITLE OF PROJECT: "An Analysis of the Legal Problems in Reclamation of Mines in Appalachia"

GRANTEE OR CONTRACTOR:
University of Maryland School of Law
500 West Baltimore Street
Baltimore, MD 21201

PROJECT DIRECTOR:
Mr. Everett F. Goldberg
Mr. Garrett Power

SPECIFIC DATA ABOUT THE PROJECT

Total Project Cost:	$44,523	Obligation Date:	June 29, 1970
Total Federal Cost:	$42,247	Completion Date:	September 30, 1971

FINAL REPORT:

TITLE: LEGAL PROBLEMS OF COAL MINE RECLAMATION (14010 FZU 03/72)

Author

Abstract

The study discusses the antecedents of today's Appalachian coal industry and the environmental problems it has created. It examines the way in which the property system allocates rights in coal and coal lands, the efficacy of litigation and present laws and regulations for preventing environmental damage, and constitutional limitations on the ability of states to effectively respond to the problems. A case study of the economics of the Maryland coal industry is also presented. Model legislation giving the states the necessary powers to respond to environmental problems, is proposed. The statute meets the mandate of section 14(c) (2) of the Water Quality Improvement Act of 1970 which provides as a prerequisite to federal participation in reclamation projects "that the state or interstate agency shall provide legal and practical protection to the project area to insure against any activities which will cause future acid or mine water pollution."

Copies available from the Government Printing Office, Washington, D. C. 20402, at $2.00 each.

INFORMATION SHEET

This sheet describes briefly a

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

Completed under the provisions of the

Federal Water Pollution Control Act, As Amended.

PROJECT NUMBER: 14010 HBQ (68-01-0063)

TITLE OF PROJECT: "Feasibility Study Sheban Impoundment and Reclamation Area"

GRANTEE OR CONTRACTOR:	PROJECT DIRECTOR:
Stanley Consultants Suite 203 6659 Pearl Road Cleveland, Ohio 44130	R. H. Anderson

SPECIFIC DATA ABOUT THE PROJECT

Total Project Cost: $16,550.00	**Obligation Date:** April 16, 1971
Total Federal Cost: $16,550.00	**Completion Date:** July 6, 1971

FINAL REPORT:

TITLE: "FEASIBILITY STUDY - UPPER MEANDER CREEK MINE DRAINAGE ABATEMENT PROJECT" (09-71)

Author

Abstract

This report presents an evaluation of the feasibility of a mine drainage control demonstration project for the Upper Meander Creek site which has been extensively surfaced mined for coal in Mahoning County, Ohio.

The general features of the recommended program include the following steps:

1. Elimination of standing pools of acidic water.
2. Regrading of the final cut to provide positive drainage from the area.
3. Preparation of a suitable seed bed and planting of acid tolerant grasses, plants, and trees.
4. Implementation of beneficial land use features following successful reclamation. This phase will be the responsibility of the agency retaining permanent control of the area and has not been included as part of the federally-aided demonstration.

INFORMATION SHEET

This sheet describes briefly a

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

Completed under the provisions of the

Federal Water Pollution Control Act, As Amended.

PROJECT NUMBER: 14030 EDB

TITLE OF PROJECT: "Evaluation of Potential Water Pollution from Spent and/or Burned Oil Shale Residues"

GRANTEE OR CONTRACTOR:	**PROJECT DIRECTOR:**
Colorado State University Fort Collins, Colorado	Dr. John C. Ward Dept. of Civil Engineering

SPECIFIC DATA ABOUT THE PROJECT

Total Project Cost:	$40,557	**Obligation Date:**	June 13, 1969
Total Federal Cost:	$38,504	**Completion Date:**	July 31, 1971

FINAL REPORT:

TITLE: "WASTE POLLUTION POTENTIAL OF SPENT OIL SHALE RESIDUES" (14030 EDB 12/71)

Author

Abstract

Physical properties, including porosity, permeability, particle size distribution, and density of spent shale from three different retorting operations, (TOSCO, USBM, and UOC) have been determined. Slurry experiments were conducted on each of the spent shales and the slurry analyzed for leachable dissolved solids. Percolation experiments were conducted on the TOSCO spent shale and the quantities of dissolved solids leachable determined. The concentrations of the various ionic species in the initial leachate from the column were high. The major constituents, $SO_4^=$ and Na^+, were present in concentrations of 90,000 and 35,000 mg/l in the initial leachate; however, the succeeding concentrations dropped markedly during the course of the experiment. A computer program was utilized to predict equilibrium concentrations in the leachate from the column. The extent of leaching and erosion of spent shale, and the composition and concentration of natural drainage from spent shale has been determined using oil shale residue and simulated rainfall.

Concentrations in the runoff from the spent shale have been correlated with runoff rate, precipitation intensity, flow depth, application time, slope, and water temperature.

Copies available from the Government Printing Office, Washington, D. C. 20402, at $1.25 each.

INFORMATION SHEET

This sheet describes briefly a

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

Completed under the provisions of the

Federal Water Pollution Control Act, As Amended.

PROJECT NUMBER: 14050 EPU

TITLE OF PROJECT: "Utilization of Phosphate Slimes"

GRANTEE OR CONTRACTOR:
International Minerals Corp.
5401 Old Orchard Road
Skokie, Illinois 60076

PROJECT DIRECTOR:
Srini Vasan

SPECIFIC DATA ABOUT THE PROJECT

Total Project Cost:	$219,792.00	Obligation Date:	October 1, 1969
Total Federal Cost:	$153,854.00	Completion Date:	December 31, 1970

FINAL REPORT:

TITLE: "UTILIZATION OF PHOSPHATE SLIMES" (14050 EPU 08/71)

Author

Abstract

Small scale tests were made to assess the feasibility of producing materials economically for the building industry from the clay slimes wastes of the Florida phosphate industry. The objective was to find practical means to utilize these clay materials in order to reduce or eliminate the vast impoundment acreage devoted to their storage and to make the water entrapped therein available for re-use.

These studies showed that it is feasible to produce a pelletized lightweight aggregate and ultimately a lightweight concrete from the slimes. It was estimated that up to 6-8 million tons of clay solids can be so used annually with the concurrent release of up to 5 billion gallons of water into the environment. Production of ceramic materisl was also explored.

Copies available from the Government Printing Office, Washington, D.C. 20402, at $1.25 each.

IV

HYDROLOGIC MODIFICATIONS

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ACTIVE PROJECTS

IV

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INFORMATION SHEET

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

This sheet describes briefly a grant under Section 6b Federal Water Pollution Control Act, As Amended

PROJECT NUMBER: 15030 FMZ

TITLE OF PROJECT: "Demonstration & Quantitative Evaluation of Storm Water Erosion and Sediment control Practices in a Developing Urban Area"

GRANTEE:

State of Maryland
Dept. of Water Resources
Annapolis, MD 21401

PROJECT DIRECTOR:

Mr. Marshall Augustine

Project Site: City of Columbia, MD

SPECIFIC DATA ABOUT THIS AWARD

Award Date: June 29, 1970

Project Cost: $436,850

Completion Date: January 31, 1973

Federal Cost: $280,000

DESCRIPTION OF PROJECT

The project consists of: (1) the implementation, demonstration and evaluation of erosion control practices; (2) the construction, operation, demonstration, and evaluation of the use of a local storm retention pond and treatment unit for the control of storm water pollution; (3) the construction, operation, and maintenance of methods for handling, drying, conditioning, and disposal of sediment. This demonstration project will be conducted in a 200 acre watershed in a section of the Village of Long Reach in the City of Columbia, concurrent with the urbanization of a presently rural area. The demonstration will extend into the post-development period to obtain information on the effects after re-stabilization of the area.

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INFORMATION SHEET

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

This sheet describes briefly a grant under Section 6b
Federal Water Pollution Control Act, As Amended

PROJECT NUMBER: 15030 FMZ

TITLE OF PROJECT: "Programmed Demonstrations for Erosion and Sediment Control Specialists"

GRANTEE:	PROJECT DIRECTOR:
State of Maryland Dept. of Water Resources State Office Building Annapolis, MD 21401	Marshall Augustine

Project Site: Columbia, MD

SPECIFIC DATA ABOUT THIS AWARD

Award Date: March 11, 1972	Project Cost: $145,100
Completion Date: January 31, 1973	Federal Cost: $98,000

DESCRIPTION OF PROJECT

The project is a continuation of the collection and compilation of information on erosion and sediment control practices used in urban development and concurrently with the original work, the development of a programmed demonstration for erosion and sediment control inspectors and other specialists. The program will be divided into three phases. The "Basic" phase will test the general aspects of erosion and sediment control and background information on climatology, hydrology, hydraulics, sedimentation, soils, geology and plant materials. The "Specialized" phase will cover the specific practices used in grading, storm runoff control, sediment basins and traps, etc. The "General" phase will cover drawings and specifications, laws and regulations and the responsibilities of inspectors, designers and construction foremem.

The project will use the information previously developed and concurrently being included as specialized techniques in the "Erosion and Sediment Control Manual." The concurrent work on the Manual and the Program will maximize their utility. Additionally, several erosion and sediment control practices will be implemented and evaluated for developing the required autodemonstration materials and information. A plan for the development of training materials and tests leading to the State certification of erosion and sediment control inspectors and specialists will be formulated.

This award is for the continuation of a project originally obligated June 29, 1970. The total project cost including this award is $581,950 and the total Federal cost is $378,000.

EPA Hq Form 5330-1 (6-72)

INFORMATION SHEET

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

This sheet describes briefly a grant under Section 5
Federal Water Pollution Control Act, As Amended

PROJECT NUMBER: 15030 HIX

TITLE OF PROJECT: "Erodibility of Urban and Suburban Construction Site Subsoils as Predicted by Chemical, Mineralogical and Physical Parameters"

GRANTEE:
Division of Sponsored Programs
Purdue Research Foundation
Lafayette, Indiana 47907

PROJECT DIRECTOR:
Dr. Darrell W. Nelson
Dept. of Agronomy

Project Site: Lafayette, Indiana

SPECIFIC DATA ABOUT THIS AWARD

Award Date:	June 7, 1971	Project Cost:	$79,155.00
Completion Date:	June 30, 1973	Federal Cost:	$75,198.00

DESCRIPTION OF PROJECT

The project is to refine an erodibility equation, previously developed for surface soils, for use on subsoils commonly found at construction sites. This will be accomplished by : (1) using a "rainulator" to test the soil erodibility model on heavier textured soils commonly found at construction sites; (2) relating various chemical, mineralogical and physical properties of selected surface and subsurface soils to their erodibility factor (K) previously determined by field experimentation (3) to arrive at an equation using data obtained in (1) and (2) that can be used by erosion control investigators to more accurately predict soil losses at construction sites.

INFORMATION SHEET

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

This sheet describes briefly a grant under Section 5
Federal Water Pollution Control Act, As Amended

PROJECT NUMBER: 15070 GCK

TITLE OF PROJECT: "Use of Dredgings for Landfill"

GRANTEE: Northwestern University Evanston, Ill. 60201	PROJECT DIRECTOR: Raymond J. Krizek, Professor Civil Engineering

Project Site: Toledo, Ohio

SPECIFIC DATA ABOUT THIS AWARD

Award Date: Sept. 9, 1970	Project Cost: $268,772.00
Completion Date: Sept. 30, 1973	Federal Cost: $230,389.00

DESCRIPTION OF PROJECT
The project will instrument, monitor and gather pertinent data from the diked dredged spoil disposal site located in Toledo, Ohio from its initial use until several months after it has been completely filled. The data collected from the Toledo site and the data collected from other sites previously sampled will be used to develop math models to represent the physical process which occurs in such a landfill operation and a water quality model to characterize the quality and deposition of the effluents. Additionally, the project will investigate the effectiveness of various chemical additives in improving the engineering properties of dredged materials.

The first year of study - the initial sampling of various diked disposal sites for determining procedures, chemical composition and physical characteristics of the dredged spoil; the selection of a virgin site for the instrumentation; and the background work necessary to design the instrumentation system required for monitoring the virgin site - has been completed. The results of the first year of the project will be used to accomplish the work in the final two years of the study. All data for the project will be incorporated in the final report.

EPA Hq Form 5330-1 (6-72)

INFORMATION SHEET

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

This sheet describes briefly a contract under Section 6b
Federal Water Pollution Control Act, *As Amended.*

PROJECT NUMBER: 68-01-0712

TITLE OF PROJECT: "Dredged Spoil Disposal Guidelines"

CONTRACTOR:	PROJECT DIRECTOR
WAPORA, Inc. 1725 DeSales St., N.W. Washington, D. C. 20036	Mr. Bernard J. Wachter

Project Site: District of Columbia

SPECIFIC DATA ABOUT THIS AWARD

Award Date: June 8, 1972	Project Cost: $58,310
Completion Date: June 7, 1973	Federal Cost: $58,310

DESCRIPTION OF PROJECT

This project is to develop planning guidelines for use by Federal, State, local and private decision-makers in selecting sites for long-term, diked-enclosure and land disposal of dredged spoils. The guidelines will include the technical, economic, environmental, political, and social factors relevant to this decision-making process and reflect the disposal site selection problems associated with coastal, lake and inland dredging areas and with spoils of varying pollution characteristics. If certain combinations of the various factors render diked or land spoil disposal undesirable, there will be alternatives recommended to minimize the environmental impacts of dredging and disposal.

EPA Hq Form 5330-2 (6-72)

INFORMATION SHEET

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

This sheet describes briefly a contract under Section 6b
Federal Water Pollution Control Act, As Amended.

PROJECT NUMBER: 68-01-0743

TITLE OF PROJECT: "Demonstration of the Separation and Disposal of Concentrated Sediments"

CONTRACTOR:	PROJECT DIRECTOR
Hittman Associates, Inc. 9190 Red Branch Road Columbia, Maryland 21043	Mr. Burton C. Becker

Project Site: Columbia, Maryland

SPECIFIC DATA ABOUT THIS AWARD

Award Date:	June 30, 1972	Project Cost:	$265,200.00
Completion Date:	June 29, 1973	Federal Cost:	$265,200.00

DESCRIPTION OF PROJECT
This demonstration project will investigate the engineering and economic feasibility and practicability of the separation and disposal of concentrated sediments from dredging operations.

Undisturbed silt will be removed from a lake or sedimentation pond by a "Mudcat", a non-stirring dredge. A portable sediment separation system will be developed based on a hydrocyclone initial stage followed by a filtration stage ("Uni-Flow Filter") to yield return water containing less than 25 ppm solids. There will be an investigation of existing alternate methods of primary and secondary separation applicable to concentrated sediments. Consideration will be given to the various methods of disposal of the concentrated sediments and the most promising method will be demonstrated.

EPA Hq Form 5330-2 (6-72)

V

HYDROLOGIC MODIFICATIONS

*

COMPLETED PROJECTS

V

INFORMATION SHEET

This sheet describes briefly a

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

Completed under the provisions of the

Federal Water Pollution Control Act, As Amended.

PROJECT NUMBER: 15010 DSZ

TITLE OF PROJECT: "Pollution Control of Bathing Beaches by Use of a Pneumatic Curtain"

GRANTEE OR CONTRACTOR:	PROJECT DIRECTOR:
National Pollution Control Foundation 866 U. N. Plaza, Room 423 New York, New York 10017	Dr. Raymond J. Moshy Staff V.P. & Director-Research American Machine & Foundry Co. 869 Hope Springdale, Connecticut

SPECIFIC DATA ABOUT THE PROJECT

Total Project Cost:	$265,584.00	Obligation Date:	May 6, 1968
Total Federal Cost:	$197,463.00	Completion Date:	October 1969

FINAL REPORT:

TITLE: "POLLUTION CONTROL OF BATHING BEACHES BY USE OF A PNEUMATIC CURTAIN" (15010 DSZ 10/69)

Author

Abstract

This project was to determine the feasibility of reducing water pollution in tidal beach areas by using aeration/chlorination systems.

The aeration did not exhibit any appreciable reduction in pollution. The chlorination, as expected, reduced the pollution, but the indicated costs would be prohibitive because of the chlorine demand of the ocean bottom and the changing tides.

No publication was made of the final report.

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INFORMATION SHEET

This sheet describes briefly a

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

Completed under the provisions of the

Federal Water Pollution Control Act, As Amended.

PROJECT NUMBER: 15030 DTL

TITLE OF PROJECT: "Community Action Guide for Erosion and Sedimentation Control"

GRANTEE OR CONTRACTOR:	**PROJECT DIRECTOR:**
National Association of Counties Research Foundation 1001 Connecticut Ave. N.W. Washington, D.C. 20036	Mel D. Powell, Director of Contract Research

SPECIFIC DATA ABOUT THE PROJECT

Total Project Cost:	$56,543.00	**Obligation Date:**	February 11, 1969
Total Federal Cost:	$41,343.00	**Completion Date:**	March 15, 1970

FINAL REPORT:

TITLE: URBAN SOIL EROSION AND SEDIMENT CONTROL (15030 DTL 05/70)

Author

Abstract

This study was conducted to determine the causes and the extent of urban and suburban soil erosion and sediment problems, and to describe ways in which local communities can organize and implement effective sedimentation control programs. An evaluation is provided on the state-of-the-art of urban sedimentation control, and a series of research needs in the sedimentation field is cited.

In addition, this report includes the "Community Action Guidebook for Soil Erosion and Sediment Control" which describes methods by which local governments can organize, plan, finance, staff, and implement urban sedimentation control programs. Aspects of areawide approaches, legal authority, and public support for sedimentation control are discussed, and an action plan is outlined.

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EPA Hq Form 5330-3 (6-72)

It was found that soil erosion and sediment in developing areas is extensive, and that these problems pose significant threats to both soil and water resources. While many technical means for controlling sedimentation problems already exist, new administrative approaches are needed which accomodate the diversity of interests and pressures also associated with urban and suburban development.

Copies available from the Government Printing Office, Washington, D.C. 20402, at $1.00 each.

INFORMATION SHEET

This sheet describes briefly a

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

Completed under the provisions of the

Federal Water Pollution Control Act, As Amended.

PROJECT NUMBER: 15030 FMZ

TITLE OF PROJECT: "Demonstration & Quantitative Evaluation of Storm Water Erosion & Sediment Control Practices in a Developing Urban Area"

GRANTEE OR CONTRACTOR:	PROJECT DIRECTOR:
State of Maryland Department of Water Resources Annapolis, MD 21401	Mr. Marshall Augustine

SPECIFIC DATA ABOUT THE PROJECT

Total Project Cost: $436,850

Obligation Date: June 29, 1970

Total Federal Cost: $280,000

Completion Date: January 31, 1972

FINAL REPORT:

TITLE: "GUIDELINES FOR EROSION AND SEDIMENT CONTROL PLANNING AND IMPLEMENTATION" (EPA-R2-72-015)

Author

Abstract

This is the first of three major documents being generated as part of the "Joint Construction Sediment Control Project" being conducted in Columbia, Maryland. Refer to project 15030 FMZ in the active projects section for more information.

The principal purpose of the "Guidelines" is to help those responsible for, or engaged in, urban construction prevent the uncontrolled movement of soil and the subsequent damage it causes. The "Guidelines" presents a comprehensive approach to the problem of erosion and sediment control from beginning of project planning to completion of construction.

Technical information on 42 sediment and erosion control products, practices, and techniques is contained in four appendices. In addition, a cross-index and a glossary of technical terms used in the document are provided. It is designed and intended for use by both technical and lay personnel.

Copies are available from the Government Printing Office at $1.75 each.

INFORMATION SHEET

This sheet describes briefly a

RESEARCH, DEVELOPMENT OR DEMONSTRATION PROJECT

Completed under the provisions of the

Federal Water Pollution Control Act, As Amended.

PROJECT NUMBER: 15040 EJZ

TITLE OF PROJECT: "Management of Water Quality in Stratified Reservoirs"

GRANTEE OR CONTRACTOR:	PROJECT DIRECTOR:
The Regents of the University of California Water Resources Center University of California Los Angeles, California 90024	Dr. H. B. Fischer, Asst. Prof. Dept. of Civil Engineering

SPECIFIC DATA ABOUT THE PROJECT

Total Project Cost: $10,898	Obligation Date: September 2, 1969
Total Federal Cost: $10,209	Completion Date: August 31, 1970

FINAL REPORT:

TITLE: "SELECTIVE WITHDRAWAL FROM A STRATIFIED RESERVOIR"
(15040 EJZ 12/70)

Author

Abstract

This study describes both theoretically and experimentally the flow into a line sink in a linearly density stratified reservoir. The geometry of the boundaries is simplified to a parallel walled duct with the line sink at the center of the fluid. The primary focus is on partitioning the flow into distinct flow regimes, and predicting the withdrawal layer thickness as a function of the distance from the sink.

Experimental laboratory experiments were carried out to verify the conclusions reached from the theoretical consideration. The observed withdrawal layer thicknesses were shown to be closely predicted by the integral solution. Furthermore, the data could be represented in terms of the variables by a single curve verifying the independence of any parameter other than the Schmidt number.

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Prototype data is still sparse, but comparison with the measurements made by the Tennessee Valley Authority indicates that in a reservoir the withdrawal layers are approximately one and a half times as large as predicted. The difference in thickness is probably explained by the presence of a certain amount of turbulence in the reservoir, and interference by the rear boundary of the reservoir.

Copies available from the Government Printing Office, Washington, D. C. 20402, at $1.00 each.

VI ACKNOWLEDGEMENTS

The following people have contributed to the technical and administrative direction of the program:

Ernst P. Hall
Supervisory Sanitary Engr.

B.S.Ch.E., W. Va. U.; M.S., U. of Pittsburgh; General Electric Co. Manager Training Program; Registered Professional Engineer in W. Va., Pa., and Ohio. 1972 recipient of the S.A. Braley Award for excellence in mine drainage research. As Chief, he is responsible for the technical and administrative direction of the program. Prior to joining research, he held various positions with the FWQA, was responsible for the air and water pollution control activities of the Consolidation Coal Co., performed research in coal refuse disposal and air pollution control at the Carnegie-Mellon University, and was responsible for engineering and production functions in the organic chemicals and plastics operations of Pennwalt Corp., Celina Stearic Acid Co., W.R. Grace & Co., and the General Electric Co.

B.S., M.S., and Ph.D. in Chemistry, University of Missouri. His principal area of interest is in the field of the chemistry of water treatment and acid mine drainage formation and he has directed many projects in that area.

Prior experience includes employment as a research chemist with Allied Chemical Co., Koppers Co., and E.I. DuPont de Nemours, Inc. He has also served as a research chemist, directing research projects for the Office of Saline Water.

James M. Shackelford
Physical Science Adm.

B.S.C.E., M.S.San.E., and Ph.D., Virginia Polytechnic Institute. Registered Professional Engineer, Virginia and Alabama. Lt. Colonel, U.S. Army Reserves. He has acted in this section as manager of various mine drainage control demonstration projects.

Dr. Thacker has been an Asst. and Assoc. Professor at Auburn University, and Director of the FWQA Susquehanna River Field Station, where he was responsible for a comprehensive river study. He was also director of a regional FWQA R&D office.

Henry Ray Thacker
Sanitary Engineer

Donald J. O'Bryan, Jr.
Civil Engineer

B.S.C.E. and M.S.C.E., Catholic University. Responsible for the direction and management of many projects in this section relating to mine drainage control and treatment.

Prior experience included management and supervisory activities related to the Elkins Mine Drainage Abatement Project and the management and direction of large projects with the District of Columbia Interstate Highway program.

B.S.Eng. of Mines, University of Pittsburgh. Past Chairman, Air & Water Subcommittee, AIME, past Member, Coal Technical Committee, APCA. He has served as the headquarters manager and as Project Officer for many projects relating to mining and control of pollution from construction and dredgings disposal.

His prior employment includes service with the Commonwealth of Pennsylvania, Division of Air Pollution Control, as Acting Chief, Abatement and Compliance. He has also been associated with Mine Safety Appliances and Pangborn Corp. as an Application Engineer, and with Research Cottrell as an Asst. Products Manager.

John J. Mulhern
Sanitary Engineer

B.S.Ch.E., Rensselaer Polytechnic Institute. She has served in the section as Headquarters Manager and Project Officer for projects relating to dredging and mine drainage.

Prior experience includes several years with Bethlehem Steel as engineer in the tin- and chrome-plating area and member of Management Training Program. Also served as an investigator of pollution incidents for EPA's Region III oil and hazardous materials pollution control program.

Patricia W. Diercks
Chemical Engineer

Kathryn V. Starr
Secretary-DMT

Miss Starr, the Section's secretary, is a highly proficient operator of the Magnetic Tape-Selectric Typewriter, as well as other office machines usually needed to operate an efficient office.

Her prior experience includes a classified position at the Federal Bureau of Investigation.

B.S.Ag.E., and M.S.San.E., Ohio State University. Mr. Hill is presently the Chief of the Mine Drainage Pollution Control Section at the National Environmental Research Center in Cincinnati, where he is responsible for the technical and administrative direction of many projects. Prior to his present position, he conducted research at the Ohio Agricultural Experiment Station and with the Public Health Service, where he investigated the use of soils for the disposal of wastes. He then joined the Acid Mine Drainage Demonstration Program, which conducted large-scale demonstration projects, principally at Elkins, W. Va. and in Pennsylvania.

Ronald D. Hill
Supervisory Sanitary Engr.

Eugene F. Harris
Sanitary Engineer

Assoc. in Arts, B.S. and M.S.San.E., University of Cincinnati. Deputy Chief, Mine Drainage Pollution Control Section, National Environmental Research Center, Cincinnati, where responsible for direction of projects involving mine drainage and porcine and metal processing wastes.

His previous employment includes service with F. Harris & Son, the Tennessee Valley Authority, with Proctor and Gamble in research and development, with the FWPCA Advanced Waste Treatment Laboratory, and as the Deputy Director of the Ohio Basin regional R&D office, FWQA.

He received his B.S. in Chemistry and completed the course requirements for a Ph.D. Did postgraduate work at NYU Oak Ridge Institute of Nuclear Studies, Michigan State University and the University of Michigan. He has over 80 publications and technical papers. Serves on various committees of AWWA, ACS, AIChE and WPCF. Named in "Leaders of Science," "American Men of Science" and "Who is Who in the Southeast." Currently is Chief of Applied Science and Technology in the Environmental Protection Agency.

He has worked at the Engineer Research and Development Labs, Oak Ridge National Lab, Executive Office of the President, (OCD), and Secretary of Defense Office for R&D (Pentagon).

William J. Lacy
Physical Science Administrator

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